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CITIES OF THE PO BASIN
AN INTRODUCTORY STUDY

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The Basin of the Po is not in the full sense Mediterranean. Myres[1] in his vegetational map of prehistoric Europe rightly marks it as a region of broad-leaved deciduous forest rather than an evergreen or summer brown country, while he also, rightly, shows that the olive barely enters its south-eastern corner. One may travel about the Po Basin and only rarely meet the olive tree, which is the characteristic, or index plant, of Mediterranean life; it is only as one approaches Pesaro that its beautiful grey green is added to the landscape.

DIVERSITY AND TRANSITIONAL CHARACTER

The simple fact is that the mountain lines that girdle the basin on north, west, and south give it an almost continental climate. Anticyclonic conditions develop in winter, and the lowland just to the south of the Po near Pavia may have a frozen January, while Emilia, facing north, also feels the cold severely. The general southward slope in Lombardy, on the other hand, has a milder climate. The great heights of the Alps catch some rain at nearly all seasons and give a perennial supply of river water from their glaciers and the great lakes, which in several cases have accumulated behind morainic dams. Emilia, on the contrary, gets less rain in winter and also less in summer and seems to depend largely on what falls during the changes of seasons. The Piedmont plain to the west with more than a semicircle of mountains opens eastward and is higher than the Lombard plain. The rainfall is on the whole less; and the aspect of most of the Piedmontese slopes promotes greater contrasts of temperature, although warm southward downslopes, like that round about

[1] J. L. Myres: Ancient History, Cambridge, 1922, Vol. 1, Map 3.

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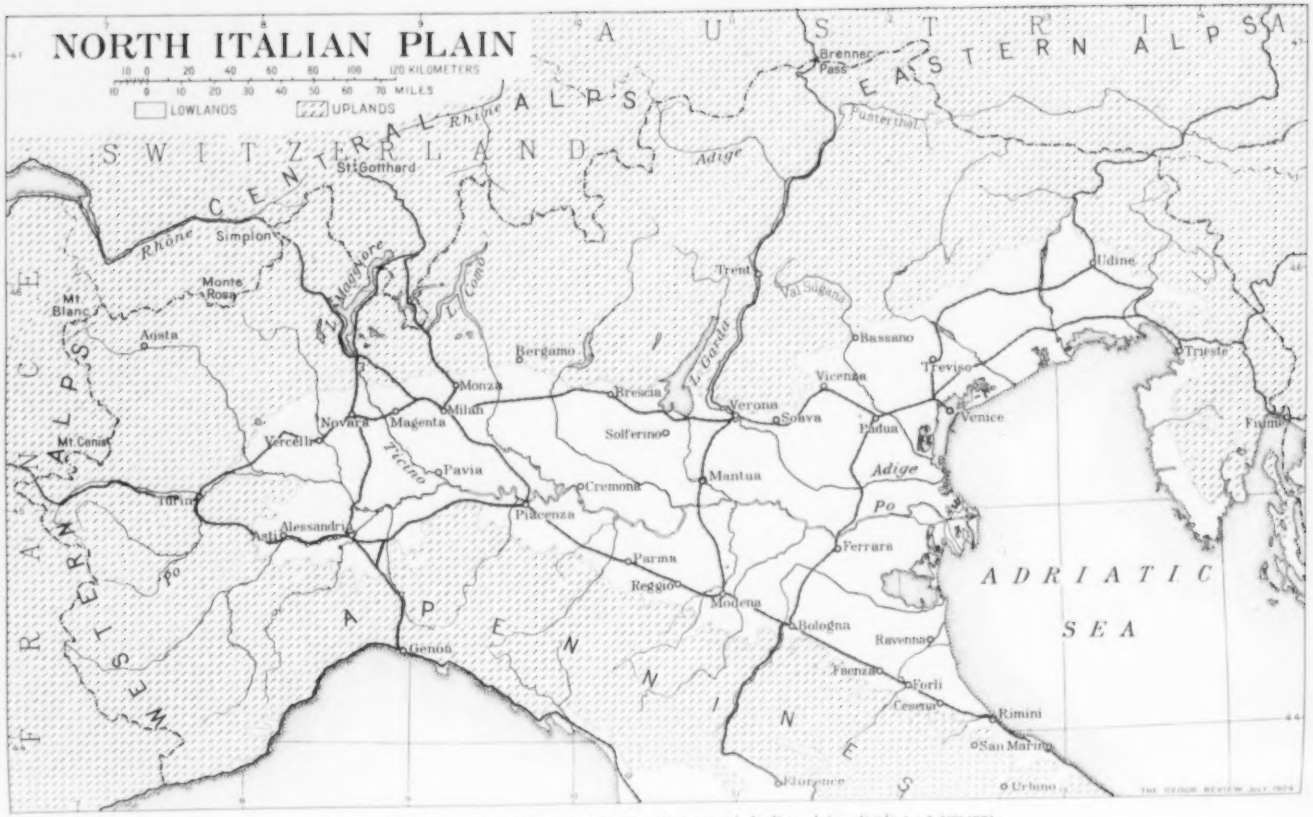


FIG. 1.—Sketch map showing the chief cities of the north Italian plain. Scale 1 : 3,000,000.

Asti, have long been famed for their vineyards. The Lombard plain also contrasts with Venetia, which has drier conditions, less constant rivers, and more winter cold. So it comes to pass that Piedmont, Lombardy, Venetia, and Emilia are to a considerable degree distinct natural regions in a physical sense.[2]

The Po has not been easy either to navigate or to cross. From prehistoric times there has doubtless been a good deal of swamp along the axial river, however much of this swamp may have become controlled by irrigation schemes. It has been a divider rather than a unifier. The region of the Po Basin has not at any time, for long, been a human unit nor the

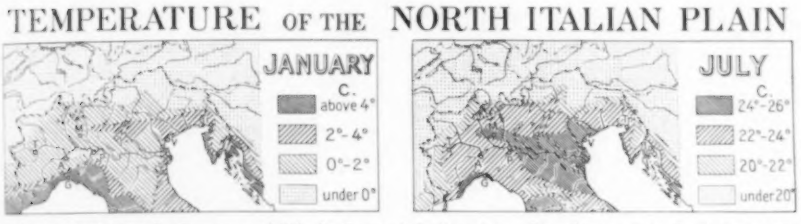


FIG. 2—Isotherms for January and July in the north Italian plain. The climate of the Po Basin is comparatively extreme: note for instance the greater range on the western shores of the Adriatic as compared with the eastern shores.

basis of any durable organization. To realize this and the great mountain walls, line behind line, between the basin and peninsular Italy is to appreciate physical reasons which, added to traditional ones, help to explain the tardiness of development of linguistic nationalism in Italy, as compared with what happened in the Paris Basin, or on the English plain. It is as true humanly as it is physically that the Po Basin is not fully Mediterranean.

In Neolithic times the lake villages of Switzerland must have been an important feature of the life of the continent. Their civilization found its easiest expansion downstream to the north. On the south side of the Alps the mountain barrier was high, the slopes difficult and perhaps very thickly wooded, transition to the plain sudden. Nevertheless this type of life passed the barriers and apparently just before bronze came into use spread lake villages among the Italian lakes and the stream beds leading to the Po. In other words Lombardy acquired elements of population and civilization from the north at least as early as the last phase of the Stone Age, and she has received them at frequent intervals ever since. The motives encouraging movement into Lombardy are obvious enough and much more marked than incentives to occupy Piedmont or Emilia or even Venetia, but the lake villagers reached all these. The population

[2] The physical and human variations in the plain of the Po are the subject of an interesting paper by Arrigo Lorenzi: Studi sui tipi antropogeografici della Pianura Padana, *Riv. Geogr. Italiana*, Vol. 21, 1914, summarized by M. E. Bénévent in *Recueil des Trav. de l'Inst. de Géogr. Alpine*, Grenoble, Vol. 4, 1916. It deals essentially with rural conditions.

of the Po Basin to this day is largely Alpine (brown-haired and broad-headed) especially in Lombardy, although everywhere one also finds the smaller dark long heads of Mediterranean type. In Venetia the Alpine broad head seems to have influenced a tall dark type of, as yet, very uncertain relationships. Researches into race history show that about the time the use of metal was arising in western Europe invaders, the so-called "Beaker people,"[3] probably not as yet armed with metal weapons, spread far and wide. There seems little doubt that they penetrated, or helped to lead a penetration, into Lombardy through the mountains, probably using the Brenner route. Thus, full early, we find in the Po Basin the meeting of Mediterranean and Central European peoples and cultures, and we have but to remember that for the Romans the region was Gallia Cisalpina to realize that they thought it foreign to their homeland.

Roman Influence on City Development

Though it might in a sense be foreign, it was yet so important as the starting point of their diverse routes into western and central Europe that the Romans worked here to make the region still more deeply their own in culture than Gaul beyond the Alps. It was more deeply Latinized than any other conquered region farther north or west; and Verona, Milan, Bologna, and many other cities retain strong Roman traditions, while Ravenna, in the marshes near the friendly Adriatic with its Byzantine connections, became the refuge of Honorius when he withdrew from Rome.

The invasions following the decay of the Roman Empire brought among other peoples the Lombards. Who they were is a matter of dispute though many would hold that they were probably a compound of Nordic, Beaker, and Alpine peoples forcing a way, like so many predecessors, through the Alps. There do not seem to be many pure Nordic types in the Po Basin; but a certain amount of fair hair is a noteworthy feature, and red hair occurs now and then. The well-known difficulty of Nordic infancy and youth in a really warm-summer climate would probably suffice to account for the present rarity of the type in northern Italy, even if it ever arrived in any numbers. The point of present interest is that apparently the northern invaders, hunting and country-loving folk, did not make so lasting an impression in the Po Basin as in the Paris Basin. The period of the weakening or submergence of city life was shorter; its renaissance, promoted by the vigor of the already half-Latinized invaders, quicker and earlier. Whereas in the Paris Basin the town of Roman times seems to have gone through a period of practical ruin, and in the south of France the regrowth of city life is distinct enough in time and expression from the decline, in northern Italy the distinction, though still marked, implies a shorter break in time and thought.

[3] See H. J. Fleure: The Racial History of the British People, *Geogr. Rev.*, Vol. 5, 1918, pp. 216–231.

FIG. 3

FIG. 4

FIG. 3—The Pineta, "Ravenna's immemorial wood," on the marshy plain between the city and the sea. (By courtesy of the Touring Club Italiano.)

FIG. 4—S. Apollinare in Classe, one of the most famous of the churches of Ravenna, the sole remaining building of her port of Classis.

Another factor, already hinted at, is important here; and that is the Byzantine connections via the Adriatic. Constantinople among its many heritages, Adriatic as well as Aegean, included the modified continuance of the age-old maritime intercourse of the Mediterranean, and the Eastern Empire kept control of numerous coastal patches around the great sea during the Dark Ages. Ravenna with its varying relations to Constantinople preserves for us memorials of city life in those troubled times; and we have traces at Torcello as well, in the northern part of the Venetian lagoons.

Ravenna, a City Apart

It is common knowledge that Ravenna was a port with its naval harbor at Classis near by. Both are now far from the sea among the fields, with the Pineta protecting the land from the shore sands; and the old marshes that made Ravenna impregnable are much reduced. There has long been no *raison d'être* here for a large city: thus it comes about that Ravenna retains almost unchanged its mausolea of the fourth and succeeding centuries, and its churches are only a little younger; both mausolea and churches are famous for their rich mosaics. The churches have indications of very early tradition in their form and detail and constitute a precious document for the interpretation of pre-medieval thought. Ravenna survives as a little country town and minor railway junction, with ten to twelve thousand inhabitants and little enough to do beyond the cherishing of ancient memories. It is a city apart and yet valuable for those who seek to understand the roots whence Venice grew. Torcello with its two churches and three houses or so, the latter built of monastic remains, is akin to Ravenna architecturally and again invaluable to show upon what basis grew the early renewal of art and architecture as the Middle Ages began in northern Italy. We may permit ourselves this short glance at Torcello, probably the first historic settlement in the Venetian lagoon, without incurring any responsibility for a treatment of Venice. The Queen of the Adriatic has so many features of her own and is so often discussed that it may well be omitted, and one might debate endlessly the question whether it should even be thought of as a city of the Po Basin.

Fall-Line Towns: Verona

The frequently sudden junction between mountain and plain in northern Italy is marked, as are similar lines almost everywhere else, by a line of towns, which here are connected with country market activities and the exchange of products between upland and lowland. Some, giving access to through ways across Alps or Apennines, are larger than others; and the character of the town varies to some extent from region to region. Among them one may note Turin, Vercelli, Novara, Magenta, Monza, Bergamo (Città alta and Città bassa), Brescia, Solferino, Verona, Bassano. Farther out in the plain, at least farther away from the mountains, is the great

focus of Milan, of perennial importance. Verona, and Turin is in similar case, in a sense combines the character of a focus with that of a town at the fall line. Here the Dolomites stand out far to the south of the general line of the Alps, and the low country between the exit of the Adige from its great valley in those mountains and the axial swamps of the basin is not very broad. Moreover, the Adige valley from Verona up, as one of the ways to the Brenner, gives Verona an added significance. From Lombard or perhaps rather from medieval times Alemannic colonies have settled in the Adige valley, and Alemannic dialects linger still near Verona.

FIG. 5—Verona. The fourteenth-century bridge of the Scaligers connecting the city with the Castelvecchio. (By courtesy of the Touring Club Italiano.)

To appreciate that queenly old city, however, one must bear in mind another consequence of its position at the exit of the Adige on to the narrow zone of plain north of the axial line of the Po. That narrow zone is the link between the great semicircle of Lombardy on the west and the Venetian plain on the east; so that Verona stands between two great regions, and its Ghibelline, Venetian, and Austrian fortifications remind us of the strategic factors that have conspired both to give it importance and to constrict its growth. When its foremost line of rulers, the Scaligers, were weakening (at the opening of the fifteenth century), it was disputed between Milan and Padua. In Napoleonic times France and Austria actually divided Verona between them for a short period.

With all these geographical factors behind it, Verona has become in a broad sense an epitome of the region. It stands in a strong position against a crossing of the Adige, and its pre-Roman existence is fairly established. Of its Roman life the fine amphitheater is the best memorial among many, and as one stands on the top wall of that immense monument one may look up to the white Dolomites reddening in the sunset or down to the plain. Beneath one's eyes lie the old town with its churches that typify the very beginning of medieval work and suggest the Byzantine as well as

Roman influences antedating that beginning, the castle that guards the bridge studded with the stone tooth work of the Ghibellines, the medieval gardens and churches, the old market place, the tombs of the Scaligers, the famous avenue of tall dark cypresses on the hillside, the little paved ways of the constricted shopping area, and, outside the gates and walls, the

FIG. 6

FIG. 7

FIG. 6—Portal of the Church of S. Zeno, Verona. The large, little-recessed, round-arched doorway is Romanesque in character. Cf. Figure 7. (Photograph by Evan Jones, University College, Aberystwyth.)
FIG. 7—Portal of the Church of S. Michele, Pavia. Recessed round-arched doorway showing northwestern influence. Cf. Figure 6. (Photograph by Evan Jones, University College, Aberystwyth.)

fortress of the Austrian rulers of last century with the new station that typifies the new Italian unity just beyond. Verona and Ravenna are the greatest of contrasts. Ravenna tells of one period in which little was being built elsewhere, and a few trains and an occasional steamer up the canal are almost all that prevent us from thinking of the little town as having slept on from the Dark Ages. Verona is full of energy, busy shops, busier markets, monuments of all periods side by side incorporated into the life of the present, bookshops filled with thought for the future to work out, efforts to maintain and redevelop the handicrafts—all is life and continuity.

An example of the continuity of tradition is to be found in Verona's greatest Christian monument, the church of San Zeno. Here we see the

earlier church as a crypt and, so far, like the crypts of many a church of Transalpine Gaul and Britain. In the Po Basin, however, that earlier church was less rude and had monuments too fine and too sacred to be hidden away, hence the crypt was left open to view from the nave of the newer, but still early, Romanesque Church. This feature, which is found

FIG. 8—The tombs of the Scaligers: the best example of Gothic architecture in Verona. (By courtesy of the Italian State Tourist Department.)

in many another early medieval church in northern Italy, distinguishes these churches from the corresponding ones in the Paris Basin and Britain. The doorway of San Zeno again brings out the continuity of tradition in Italy. In the Paris Basin and Britain the early medieval builders used the idea of the round arch but often were not able to make more than a small one. To increase the size and effect of their arched doorways they added arch over arch, each projecting a little in front of the one beneath, so that the actual doorway was deeply recessed. The beauty of these doorways at Avallon, Caen, and Canterbury—to name only a few—is generally known. At Verona the round-arched doorway is large and less recessed; the skill and resources of the builders were here sufficient to the task; and the doorway is thus characteristically different from the type found in northwestern Europe. Recessed round-arched doorways of northwestern

type, however, are found at several places in the Po Basin, again illustrating the transitional situation of the north Italian plain.

The difficulties of the Romanesque architecture for the builders of the northwest led them to modify it into the Gothic style, which generally uses the pointed arch. The Paris Basin is the home of this style, whence it spread to Britain, the Low Countries, and Central Europe. In southern France and in Italy it met only with very partial success. At Verona the Gothic style is best seen in the tombs of the Scaligers, which are protected by the finest flexible lacework in wrought iron. The Gothic style is nevertheless most obviously not at home in Verona, and one might say much the same of northern Italy generally, in spite of San Petronio at Bologna and the Cathedral at Milan.

Milan, a Focus of Ways

If Verona, in the tombs of the Scaligers and the German dialects of its district (the Sette Communi)[4] shows northern ideas, Milan shows them not only in its strange cathedral but also in many details of its streets, its monuments, and its life. A focus of ways through the Alps (including the St. Gotthard and Simplon routes), its military importance has been of the greatest and was undoubtedly restrictive of other developments in centuries past. In the Middle Ages it concerned itself with wool; but from 1850, when the idea of silkworm rearing and mulberry leaf culture spread on a large scale in Italy, Milan was able to supersede wool by silk and, like many another primary industrial center, has advanced to the secondary stage of supplying machinery, credit, and organization. The utilization of hydro-electric power at a distance from its source in the last decade of last century gave the Po Basin, and especially Milan, a great opportunity, for it solved old difficulties due to lack of coal or oil. Hydro-electric power was spreading also in Switzerland, South Germany, and Austria; and many new commercial links were developed between Milan and the cities on the northern side of the Alps, accentuating and renewing connections centuries old through movements of technicians, directors, and capital between the various centers. For these reasons, as well as because it was assuming the character of a financial metropolis, Milan has been becoming more cosmopolitan; and the contrast between it and Verona is about as striking as that already mentioned between Verona and Ravenna. With abundance of clean power and a long tradition of dexterous workmanship and of taste, Milan and cities similarly placed may have a great future industrially, with less degradation than seems to be characteristic where coal industry creates huge agglomerations of people in places previously of little account. These tendencies are further helped by the occurrence of rich cultivation around the city.

[4] Leon Dominian: The Frontiers of Language and Nationality in Europe. New York, 1917, pp. 68–69.

Cities of Lombardy and Piedmont Compared: Turin

The cities of the fall line in Lombardy often have rich treasures of art in many fields and sometimes exploit hill sites of delightful character, though old-time fortifications have often made their centers crowded and poor, if picturesque. Soave, on its hill, may be mentioned as a most interesting little one, gathering around a castle. There are also beautiful sites on the great lakes and on their fine islands. Villages are on the whole

Fig. 9—Turin, occupying a strategically and commercially important situation at the western end of the north Italian plain. (By courtesy of the Touring Club Italiano.)

more characteristic of the hills, where some picturesque old hamlets stand on little pasture ledges, *alps*, high up the hill slopes and where torrents turn old mill wheels. In the plain the large farm establishment is more characteristic, and its extensive buildings bespeak a good deal of organization. The roof of the dwelling house is often continued beyond a reëntrant angle on the south or southwest side of the house, and its edge is then supported on pillars so that much of the life of the household can go on out of doors under its protecting shade.

In Piedmont there is rather more of a feeling of northwestern Europe. Turin is a Roman city, and the Roman roads have helped to determine the modern streets; but, as usual, the present streets may not be exactly on the Roman lines, for these have been covered up, and little deflections may have accumulated. Turin became the usual seat of the dukes of Savoy comparatively late, in the second half of the sixteenth century, and rather lacks medieval splendor. Many a little town or large village of Piedmont gathers around its castle and is often provided with walls and gates, which, as at Arquata Scrivia for example, have led to congestion within, though

the narrowness of the alleys is doubtless also a protection against the sun. The concentration of the people into groups, large and small, is characteristic here again, though there are also farms scattered over the country. Many of the old towns have interesting early Romanesque churches, but there is not the magnificence of Lombardy and Verona. The mulberry is largely lacking, and silk has not superseded wool; but hydro-electric power has led to machinery development, and Turin, for example, has great fame in engineering.

Padua and the Universities

From the Adige and Verona eastward one moves into another land, the coastal plain; and here perhaps the Byzantine connections, perhaps the influence of Venice and its famed campanile, perhaps the flatness of the plain, probably all these three factors together, have led to the building of churches with tall slender spires and campaniles, whose proportions are often very different from those of Lombardy. On the northern side of the axis of the Po Basin the great town of the coastal plain is the learned Padua with its ancient and magnificent town hall on the market place; with its memories of Dante and of Giotto, whose frescoes in the church of Santa Maria della Arena are its pride; and with its university, probably next in age to that of Bologna and the historic rival of that mother of learning. The city stands, as it were, over against Venice, and land travel from the old commercial metropolis would use Padua whether it were aiming at Verona and Lombardy, or Verona and the lower Adige, or the Val Sugana and the upper Adige, or the col d'Ampezzo and the Pusterthal on the way to the Brenner, or the coastal plains to north or south. It is thus a gathering place for Venice, as Bologna is a gathering place for travel southward to Tuscany and Rome, and Pavia on the Ticino a gathering place for crossing the Po which, below that town, becomes a barrier with swamps, and now dikes, on either hand. There are several other universities in the Po Basin below Piedmont, where Turin carries the renown of learning; but these are the three of sustained and world-wide fame, and their sites illustrate what has been so characteristic in the growth of historic universities, namely their development at purposeful gathering places, places where men of diverse origins and outlooks gather to travel along a common way. At Bologna the nations, as represented by their pilgrims and wandering students, met to improve their Latin on their way to Rome and learned the law that Rome handed down; and the faculty of law was long supreme at the senior university. Padua and Pavia we have noted in passing, and we might illustrate the same points from Paris, Leipzig, Louvain, or Prague, or even from Oxford or from Cambridge. It is probable that with the huge development of communications this factor no longer operates in quite the same way; but there can be little doubt that the mingling of groups of diverse origins and minds is still an essential for a healthy university. Of the lesser universities of the Po Basin,

one may just mention Ferrara, on the south side of the Po crossing, because it illustrates the same point though in a minor degree.

Towns of the Via Aemilia

The contrast between the northern and southern sides of the Po is a very marked one, as has already been suggested. The wealth of cultivation is

Fig. 10—Pavia, a "bridge town" of the Ticino near its confluence with the Po: a meeting point of routes. (By courtesy of the Touring Club Italiano.)

on the northern side with great and handsome establishments, the most remarkable irrigation in Europe, fruit orchards, mulberry hedges, fields of wheat and of maize, diked and, in the season, flooded rectangles near Pavia for rice. On the southern side there may often be mulberry hedges, and fields of wheat and maize are general; but neither is the irrigation so well developed nor is the cultivation so rich. The farmhouses are often poor and in the poorer parts of the Romagna grade down at times almost into shacks. The verandas of Lombardy are rare here, for the winter is severe.

The towns on the southern side of the Po are mainly of the nature of fall-line towns and have grown up along the Via Aemilia which gives its name, the name of its builder, to the region below the northern flank of the Apennines to which it contributed the germs of unity. These towns vary according to their opportunities and especially according to their trans-Apennine connections, and on this ground Bologna stands out. Rimini has the advantage of being at the sea end of the straight road, and Piacenza is at the Po end of the line. Rimini, like Ravenna, owes something of its strange character to the eastward sea, though its eastern connections affected it chiefly at the end of the Middle Ages and not, as did those of Ravenna, in the days of decline of imperial Rome. Its riverside quays accommodate a few steamers and a fleet of brilliant-sailed fishing boats

that flock out and in according to wind and tide. The south gate of the city, a true and great Roman archway, is surmounted by the proud tooth work in stone of the Ghibellines; and the rough and formidable Malatesta castle guarded the ways from the land where the great isolated hill of San Marino dominates the near view and serves as a reminder of the days when little communities, or their lords, did as seemed good in their own eyes. San Marino's hill is but the greatest of many outposts of the northern flank of the Apennines, and on many another a townlet clusters under a baron's castle with narrow irregular streets that made defense easier in

FIG. 11—The canal connecting Rimini with the Adriatic. Rimini commands the southeastern corner of the north Italian plain: it is at the junction of two famous Roman roads, the Via Flaminia and the Via Aemilia. (By courtesy of the Touring Club Italiano.)

times of street warfare. The ravines of the Apennines have old castles here and there, but the queen of them all on the northern flank is the magnificent eagle's nest of Urbino, standing on an almost isolated spur that looks down on deep ravines for three parts of its circumference and on a fairly low neck for the rest. It owes its special importance to its command of the way through the mountains to its sister fortress of Perugia on the Tuscan side.

Along the Aemilian Way at intervals stand market towns like Cesena, Faenza, and Forli. Faenza is the greatest of these three, because it has ways through the Apennines that are used by the railway, as well as because it has so long had, and is now redeveloping, its tradition of the making of the ware which takes its name "faïence" from the little town. The Roman road runs through each, at times with a slight deflection that is so characteristic, a result of little interferences with the original plan; and there are or have been gates on the great way, mansions near the town center, and a town hall and often a great church on the big market square. But these little towns on the eastern side of the Via Aemilia, as well as Parma, Modena, and Piacenza on the western side, are utterly eclipsed

by the mighty Bologna at the northern end of what has been from Roman times at least, and probably much longer still, the main artery of communication between the Po Basin on the one side and Tuscany and Rome on the other.

Bologna, Mother of Universities

The story of Bologna goes back to Neolithic days at least, but its importance seems to date from the earliest Iron Age and to be maintained

Fig. 12—Rimini: the bridge of Augustus, built 14 A. D. Rimini (Ariminum) was long a frontier station of Rome, the last before the crossing of the Rubicon. (By courtesy of the Italian State Tourist Department.)

through Etruscan and Roman times to the Middle Ages and our own day, with every likelihood of its continuation for an indefinite future. If the university, as already discussed, illustrates the multiple contacts in an, at times, more or less peaceful sphere of activity, the many tall towers of the aristocratic families equally illustrate the warlike contacts at this strategic site; it is a town with a stormy past, with Guelph wresting power from Ghibelline, with a Senate that in good days made much of the Palazzo Communale and a people who not only built the wonderfully decorated Archiginnasio, the Renaissance home of the university, but before that had aspired to build what was to have been the greatest church in Christendom, the immense but incomplete San Petronio in the Gothic style worked out in brick. The mysterious "Seven Churches," so-called, go back to the verge of the Dark Ages; the Middle Ages, century by century, are represented in churches and mansions or fortresses. The Renaissance is everywhere about and hardly anywhere so characteristically as in the arched arcading which shelters the footways along most of the chief streets and makes a contrast with the lack of protection for foot passengers either from carts or from rain in so many other Italian towns.

Summary

With these references to the mother of universities we may close this introduction to the study of the geographic factors affecting the forms and general characteristics of the cities of the Po Basin. In climate and vegetation it is intermediate between the truly Mediterranean lands and Central Europe, in human things it is a region marked out by the rivalry of both from prehistoric times down to the present and the opening future. Structurally a clear unit, its variations of climate and of relations with lands beyond the Alps and the Apennines and the sea have prevented it from achieving any large measure of human unity in face of its axial river barrier. In place of growth towards regional unity we follow, in its story, growth of expression of the city idea. Already strong in Roman times, we see it surviving the Dark Ages and bursting forth again as soon as intercourse is on the way to reëstablishment, and the thought that lands north of the Alps in the Middle Ages were able to buy a good deal, thanks to enrichment from their iron industry, helps us to interpret the special importance of several cities of the Po Basin at that time. Contentions of Papal and Imperial factions, that is rivalry of relations with lands beyond Apennines and Alps respectively, give the cities many features that attract the visitors' interest, and these contentions may be drawn into the argument that seeks to demonstrate the difficulty of regional unity. The relative slowing down of Mediterranean activity after the discovery of America and the Cape route to the Indies left the region to Austria and the Papal States, that is to a continuation of the old thought while France, for example, was enforcing its unity under Richelieu and his successors. Not until the railway epoch did the old scheme finally crumble. That it was the traditional commanders of the northwestern Alpine passes, the House of Savoy, with long habit of diplomacy who became the first rulers of the new unity rather than the lords of the various more commercial cities is a point to dwell upon. The unity remains external and has left the abiding diversities still very strong underneath.

The rise of unity or, at least, the diminution of strife has made possible the increase of attention to cultivation and industry, which has been such a feature for the Po Basin of the last two generations. Swamps are drained and water supplies are reorganized, so that even visitors from northwestern Europe have been known to take no harm from fairly long summer visits to Ferrara and even to Ravenna. Farm buildings and general sanitation improve, and the latter point inevitably suggests the need for a studious survey of the geographic influence resulting from the advance of medical knowledge. Wealth increased up to 1914 and should increase again, and it seemed likely that an old tradition of taste and fineness of work was going to interweave itself with applications of industrial power on the large scale, almost for the first time. Old strong rich

cities and rich agriculture still advancing side by side offer a subject of thought to anyone with a taste for prognostication. Such a one should bear in mind that the new developments do not altogether facilitate the problem of Italian government, the needs of Lombardy and Emilia may with care be met under one and the same system of legislation, but to suit them both and also the region of *latifundia* in southern Italy is another matter. Especially does the problem appear formidable when it is realized that Italian unity is a new thing and that the world's life seems moving away from its satisfaction with the idea of the representatively-governed sovereign nation state built on a basis of linguistic unity. The basin of the Po gives us a picture of another kind, of cities gathering their districts around them, cities which are not merely market towns with a fleeting phase of independence, but which rather show evidences in their monuments and their life of a continuity of culture and a long tradition of sovereignty. It is this feature that makes them contrast so deeply with the cathedral and castle cities, for example, of the Paris Basin.[5]

[5] H. J. Fleure: Some Types of Cities in Temperate Europe, *Geogr. Rev.*, Vol. 10, 1920, pp. 357–374.

CRATERS OF THE MOON NATIONAL MONUMENT*

By HAROLD T. STEARNS
U. S. Geological Survey

"An area of about sixty miles in diameter, where nothing meets the eye but a desolate and awful waste; where no grass grows nor water runs, and where nothing is to be seen but lava."[1] Undoubtedly Irving's description has reference to the area now known as the Craters of the Moon region of Butte and Blaine counties, Idaho, a part of which is now set aside as a national monument. This region is situated 14 miles southwest of Arco, Ida., at the foot of the White Komb Mountains on the edge of the Snake River plateau, an extensive elevated lava plain covering most of southern Idaho. Westward this plain unites with the Columbia River plateau, and together they form a vast lava field over two hundred thousand square miles in area, surpassed in size only by the Deccan traps of India and the Paraná lava field in South America. The Craters of the Moon region received its name because of the similarity of its topography to that of the surface of the moon as seen through a telescope. The comparison is not highly exaggerated; for the topography, especially in the northern part, when viewed from the top of Big Cinder Butte, is simply a barren, rugged, black surface dotted thickly with pits and craters.

The remarkable phenomenon of the region is the "Great Rift" out of which the lava welled in a series of eruptions that terminated certainly not more than a few centuries ago. The rift begins in the sedimentary rocks in the foothills of the White Komb Mountains and extends for about 14 miles southeastward, whence it enters an unexplored portion of the Snake River plain. It is possible that the craters and black lava 18 miles west of American Falls belong to a southerly extension of this same rift. If so, the rift is over 50 miles long. While such rifts are common in the older volcanic regions of the United States, the surface phenomena accompanying them have been removed because of long periods of erosion, so that the dike, or the feeder, of igneous rock is all that remains. Up to the time of the discovery of the Great Rift, volcanic phenomena that accompany a fissure eruption were not known to exist in this country. Although the area was visited twice by I. C. Russell, who described it as the Cinder Butte region,[2] the rift was not discovered until May, 1921, when Mr. O. E. Meinzer, Geologist in Charge, Division of Ground Water,

*Published by permission of the Director of the U. S. Geological Survey.

[1] Washington Irving: The Adventures of Captain Bonneville, U. S. A., Hudson edit., New York, 1868, p. 203.

[2] I. C. Russell: Geology and Water Resources of the Snake River Plains of Idaho, *U. Geol. S. Survey Bull. 199*, 1902, p. 72.

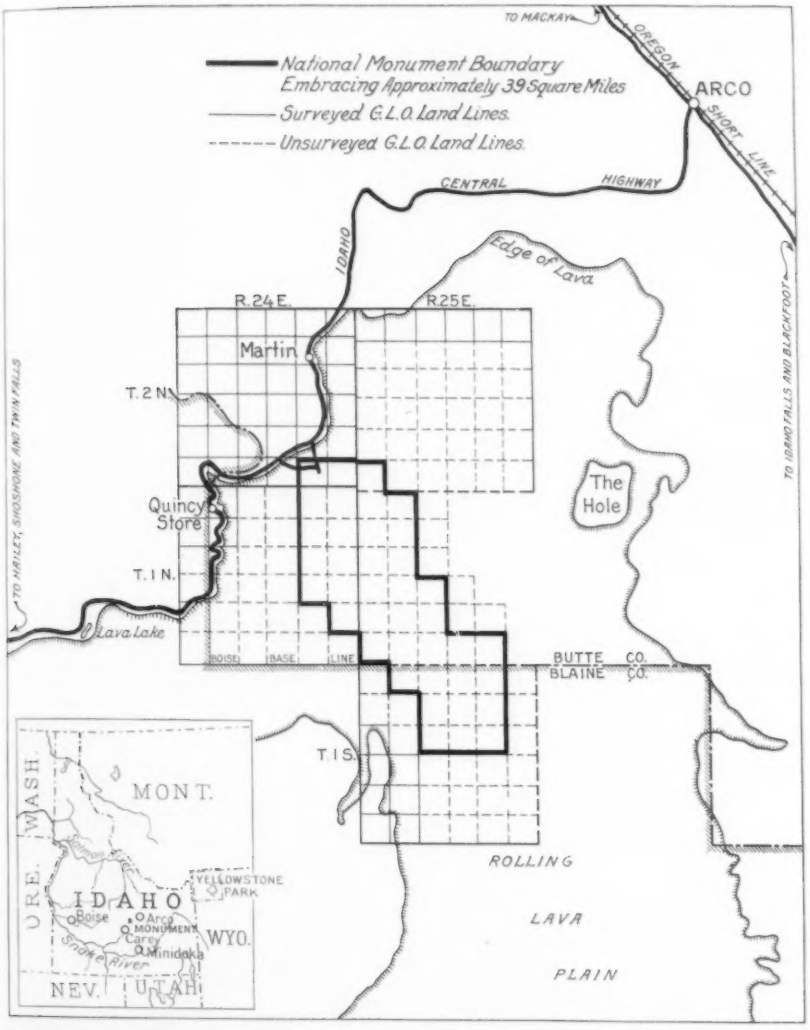


FIG. 1—The Craters of the Moon National Monument, Idaho, from a map by the National Park Service accompanying the proclamation. The inset shows the general situation of the Monument.

U.S. Geological Survey, made a note of it. Following his advice the writer visited the area the same year; but it was not until August, 1923, when Dr. F. E. Wright, of the Carnegie Institution, Washington, D. C., accompanied the writer on a second visit, that the full significance of the discovery was known. Dr. Wright, who had seen similar fissures in Iceland, recognized it immediately as a true fissure eruption. In 1921 R. W. Limbert, of Boise, Ida., visited the area and gave it considerable publicity because

FIG. 2

FIG. 3

FIG. 2—Cinder crags, portions of cones floated away on the surface of a lava flow near the entrance to the Craters of the Moon National Monument. Note that the original stratification is still preserved. (Courtesy of U. S. Geol. Survey. Photograph by I. C. Russell.)

FIG. 3—A row of hornitos along the Great Rift with Big Cinder Butte and its encircling crater rings rising 1000 feet above the plain. The hornito in the foreground is the natural ice well. (Photograph by Harold T. Stearns.)

FIG. 4

FIG. 5

FIG. 4—Looking northeast along the fissure toward Big Cinder Butte, showing the crater pits 10–20 feet deep in the foreground. (Published by permission. Photograph by F. E. Wright.)

FIG. 5—The last trickle of lava that spilled out from the crater of a cinder cone. (Courtesy of U. S. Geol. Survey. Photograph by I. C. Russell.)

of the remarkable caverns, natural bridges, craters, and other features he found there.[3]

Such, in fact, is the unique character of the region that in January, 1924, the writer was asked by the National Park Service to submit a report describing the area, delineating the boundaries, and stating the reasons for its preservation as a national monument. This was done, and on May 2, 1924, the area was created a national monument by presidential proclamation.

General View of the Area

The plant life of the region is scant. The younger lava flows are entirely devoid of vegetation except for a few lichens that cling tenaciously to the barren surface. On the cinder cones there are occasional tufts of wild buckwheat and a few scattered, stunted piñon pines. The older lava flows, however, support a sparse growth of grass, brush, and stunted pines. Animal life is similarly limited. There are a few chipmunks, ground squirrels, rock chucks, and small desert birds. However, people living near the area say that not many years ago the caves and caverns were favorite places in which bear would "hole up" during the long winter months, and here, as elsewhere in our western country, the occasional yelp of a coyote indicates that this nightly prowler frequents the few scattered water holes of the region.

A journey of about ten miles in a southerly direction from Arco through a few irrigated ranches in the valley of Big Lost River brings one to Martin, a solitary outlier of civilization at the foot of the White Komb Mountains. Here is caught the first glimpse of the frozen stream of barren black lava that poured out of a crater along the rift on the hills to the west and flowed down through a near-by valley. On the crest line of these hills, a thousand feet or more above the plain, can be discerned, sharply defined against the white sedimentary beds of the White Komb Mountains, several cones composed of red cinders. Upon leaving Martin, the edge of the foothills is skirted for about three and a half miles, and now and then glimpses of black lava are caught on the east side of the road.

As soon as the area of the Craters of the Moon National Monument is reached the entire character of the topography changes. In front is a vast plain sloping southward from an elevation of about 5000 feet at the entrance of the monument to about 4000 feet above sea level at the southern end. Progressing southward one comes upon a huge black stream of lava spread out on the plain for miles. One is reminded of Thoroddsen's description of the view from the Icelandic volcano, Odádahraun, "the weirdness of desolation itself. As far as the eye can see, the surface of the earth resembles a gigantic stiffened corpse, petrified, black as the night."[4] Although

[3] R. W. Limbert: Among the "Craters of the Moon," *Natl. Geogr. Mag.*, Vol. 45, 1924, pp. 303–328.

[4] Thorvaldur Thoroddsen: Explorations in Iceland During the Years 1881–98, *Geogr. Journ.*, Vol. 13, 1899, pp. 251–274 and 480–513; reference on p. 270.

smooth from the distance, upon closer inspection it appears astonishingly rough, covered with jagged fragments of lava and floated crags of cinders. Continuing southward, one is confronted by cinder cones one after another, large and small, high and low, until one is lost in amazement at their sameness.

From the top of one of the cones, let us say Big Crater, a remarkable view of the numerous craters and their arrangement is obtained. To the east stretches black, barren lava until it fades into the desert haze. Not a sign of life or vegetation breaks the monotony except one small, yellow, grass-covered knoll that was not inundated by the floods of lava and now stands like an island in a black sea. To the west for about six miles the lava has flowed against the southern spur of the White Komb Mountains, filling the valleys as if they were bays and leaving the ridges like projecting headlands in a black sea. Black and barren as it is, the lava surface yet has a weird scenic charm.

To the southeast extends the trough of the Great Rift. In the foreground it is studded with pits, but farther away it opens into dark yawning craters and finally loses its identity in the chaos of high cinder cones. To the northwest the plain is covered with cinder cones, craters, and hornitos, most of which are strung along the trough of the Great Rift. These cones vary in size from small cinder piles 20 or 30 feet high to huge cones which rise a thousand feet above the lava plain. On the tops of many of them crater pits are discernible, especially when viewed under the lengthened shadows of evening. Some of the cones, however, such as Crescent Butte, are merely remnants of larger cones partially destroyed by subsequent explosions.

Unusual Sources of Water

There are no streams in the whole area, the entire precipitation either sinking into the ground or being returned to the atmosphere by evaporation. Nevertheless, water is available to the traveler in several unusual ways. There are three distinct types of occurrence of water in the region. Most striking is the natural ice well near the Bottomless Pit. It is the throat of a small cone on the lava surface with an opening about four feet in diameter. A crude ladder 30 feet long reaches the bottom of the pit resting on a heap of snow about eight feet high. Here on a hot summer day one can refresh one's self with ice water or clean white snow. The bottom of this spatter cone is in the shadow of its walls except for about an hour each day, which is not long enough for the sun to melt the snow of the previous winter.

An interesting spring, which must be supplied by melting ice, occurs about 600 feet southeast of North Crater in the bottom of a pit filled with fragmental lava. On August 25, 1923, the temperature of the water was 34° F. while the air temperature was 87° F. Several other springs of this type are found among the lavas.

A third type of occurrence is that of the lava tunnels. Here the water is due to the precipitation percolating downward through cracks into long tunnels and caverns developed in the lava at the time of eruption. The water collects on the floor of the tunnels in pools; and in winter, when conditions are right for cold air to circulate through the tunnels, the water freezes. In some tunnels ice so formed during winter never entirely melts in summer so that year after year the mass of stored ice increases.

Craters and Hornitos

After the opening of the Great Rift the liquid basalt welled out in tremendous amounts, spreading over the adjacent plains in the form of a huge sheet from 25 to 75 feet thick and covering many square miles. Concurrent with the first welling out of the lava and occupying an important rôle at the close of the period of volcanism, were many explosions along the rift during which ash, cinders, and volcanic bombs were ejected. Evidently some of the explosions were long and continuous while others were very brief. At Big Cinder Butte the explosions must have been on a gigantic scale, although varying in force. They built up a cinder cone 1000 feet high representing about 7,000,000 cubic feet of fragmental lava. Judging from the remnants of the craters encircling it, Big Cinder Butte itself must represent merely the last stage of the eruptions. In the top of this cone there are several crater pits, two of them several hundred feet deep. These are elongated in the direction of the rift.

Evidently slight changes in the fissure caused the point of outflow to shift, and this resulted in the building of successive intersecting crater rings. In some places, as, for instance, in the middle portion of the rift, the lava welled out without actually forming a crater. There is only a band of red scoriaceous lava to mark the site of the fissure. In other places the fissure is marked by a line of cinder pits from 10 to 20 feet deep.

In some cases the lava rose in the throat of the cone until it spilled over the lowest place in the rim, whence flowing down the side it eroded channels several hundred feet deep and floated off on its surface huge fragments of the cone. In other places the lava spilled over the rim of the crater as a mere trickle, not even reaching the plain below.

The structure displayed in the walls of the cinder cones is simple, as a rule. The beds consist largely of cinders and bombs dipping away from the crater and increasing in steepness progressively from the bottom of the cone upwards. Sometimes thin beds of lava are interstratified with the cinders, but generally the structure indicates a continuous explosive eruption either before the lava flowed out or as the last phase of the extravasation.

In some places along the Great Rift, as between Big Crater and Big Cinder Butte, and again at several places south of Big Cinder Butte a row of hornitos was developed. The hornitos are miniature cones from 10 to

FIG. 6

FIG. 7

FIG. 6—Four-ply lava rope on surface of lava flow near Big Cinder Butte. (Published by permission. Photograph by F. E. Wright.)

FIG. 7—Lava mortar showing beautiful rifling in the throat. Near Big Cinder Butte. (Photograph by Harold T. Stearns.)

50 feet high caused by the blowing out of lava by jets of steam or gas. In fact, some of them seem to have been produced by lava fountains such as are frequently seen today at the volcano of Kilauea in the Hawaiian Islands.

In all these features there is close resemblance with the results of volcanism in Iceland.[5] The characteristic terraces formed by subsidence along the sides of the fissures are, however, absent along the Great Rift of the Craters of the Moon.

Detailed Features of the Flows

Both *pahoehoe* and *a-a* lavas are found in the region. The *pahoehoe* lava comprises the streams of lava with broad, relatively smooth surfaces that spread out like thick molasses over the plain. The *a-a* lava was extruded with a high gas content and moved very slowly. As a whole, it is more crinkly, vesicular, and broken than *pahoehoe*. An especially striking feature of *pahoehoe* lava is the ropy structure. While this feature is common in most lava flows, it is here developed almost in perfection.

The lava caves and tunnels are perhaps the most interesting features in the flows. The tunnels were formed when the lava flowed out from under a cooled crust that was strong enough to remain standing. Some of the tunnels in the Monument are 30 feet in diameter and several hundred feet in length. The interiors exhibit beautiful blue and red stalactites and stalagmites of lava. In some caves the stalactites are a foot or more in length, and where the lava has dripped to the floor of the cavern stalagmites equally large have been built up. The walls of some of the tunnels are scored by parallel horizontal lines, marks left by a gradually subsiding river of lava that flowed through the cavern while it was in the process of formation. Large portions of the roofs of these tunnels have fallen, and in some places natural bridges have been formed by a part left standing. The most notable example, known as the Bridge of the Moon, occurs in the southern part of the region.

A peculiar group of surface features is developed southwest of Big Cinder Butte. A few feet from the edge of the fissure there are a dozen little towers of lava from two to five feet high, apparently developed by lava accumulating around jets of steam or gas. The throats of most of those examined exhibited a spiral structure. Similarity of this structure to the rifling of a cannon and similarity in size and shape to the mortars used in the Civil War have led to the term "mortars" for these forms. The rifling is beautifully displayed in the one shown in Figure 7. Others, like the one in Figure 8, show several bores which taper inward and finally unite to form one main tube. The shape of one mortar showed clearly that after the column of steam or gas had quieted down the mobile walls had slumped

[5] Thorvaldur Thoroddsen: Island. Grundriss der Geographie und Geologie, *Petermanns Mitt. Ergänzungsheft No. 152*, 1905, and *No. 153*, 1906.

inward, partially sealing the opening. The bores of the mortars are usually filled with débris from 10 to 20 feet below the surface. The openings probably do not go to great depths and most likely connect with the fissure near the surface.

Lava gutters (Fig. 9) form another curious feature of the flows. These are formed partly by a process of levee building by the lava current and

FIG. 8

FIG. 9

FIG. 8—Mortar with two openings which taper inward to unite in one main tube. Black spot on the right is second opening. (Photograph by Harold T. Stearns.)

FIG. 9—Lava gutter near the ice well. (Photograph by Harold T. Stearns.)

partly by channel erosion while the current flows down a relatively steep grade on a partially congealed lava flow. They are usually from 1 to 3 feet wide, from 1 to 4 feet deep, and from 50 to 150 feet long. In some places the liquid lava in flowing through the gutters became cooled at the surface so as to form a crust. In some gutters this crust extended from one wall to the other, forming a slightly arched roof above, while the still-liquid lava beneath flowed out. In this way some of the gutters became tubes or small tunnels. The one illustrated in Figure 9 shows clearly that this gutter had been a tube, but the roof collapsed when the lava finally drained out.

Age of the Lava Flows

It is evident that the eruptions along the rift were spasmodic and occurred during a period of at least a thousand years. Some of the flows in the southern part of the area have a thin mantle of wind-blown soil, whereas in the northern part they are free even from dust and as fresh as though poured out yesterday. Although various guesses have been made regarding the age of the fresh lavas, it is generally agreed that they must have been extruded since the discovery of America. Further evidence will probably be found by a more detailed study of the region. In more humid areas, like the Hawaiian Islands, lava flows only 30 or 40 years old support more vegetation. However, under the semiarid conditions of this portion of Idaho the growth of vegetation cannot be compared with that of the humid Hawaiian Islands.

The Great Rift, with its crater chain, not only exhibits many unusual volcanic phenomena but offers a solution to the problem of how the Columbia River lava plateau was formed. The origin of the Columbia River lavas has always been a problem. Erosion has exposed great thicknesses of lava without, however, exposing a sufficient number of vents apparently large enough to account for their origin. In all probability when erosion has removed the cones and craters of the Great Rift, the solidified feeder of lava that supplied it will prove to be not more than 50 feet in width and possibly only 10 or 20 feet. Some of the small and insignificant dikes that are exposed in the Columbia Basin, therefore, might well be lower portions of a large rift and have supplied the numerous sheets of lava that cover hundreds of square miles.

GEOGRAPHICAL NOTES ON ESMERALDAS, NORTHWESTERN ECUADOR

By Carlos M. Larrea

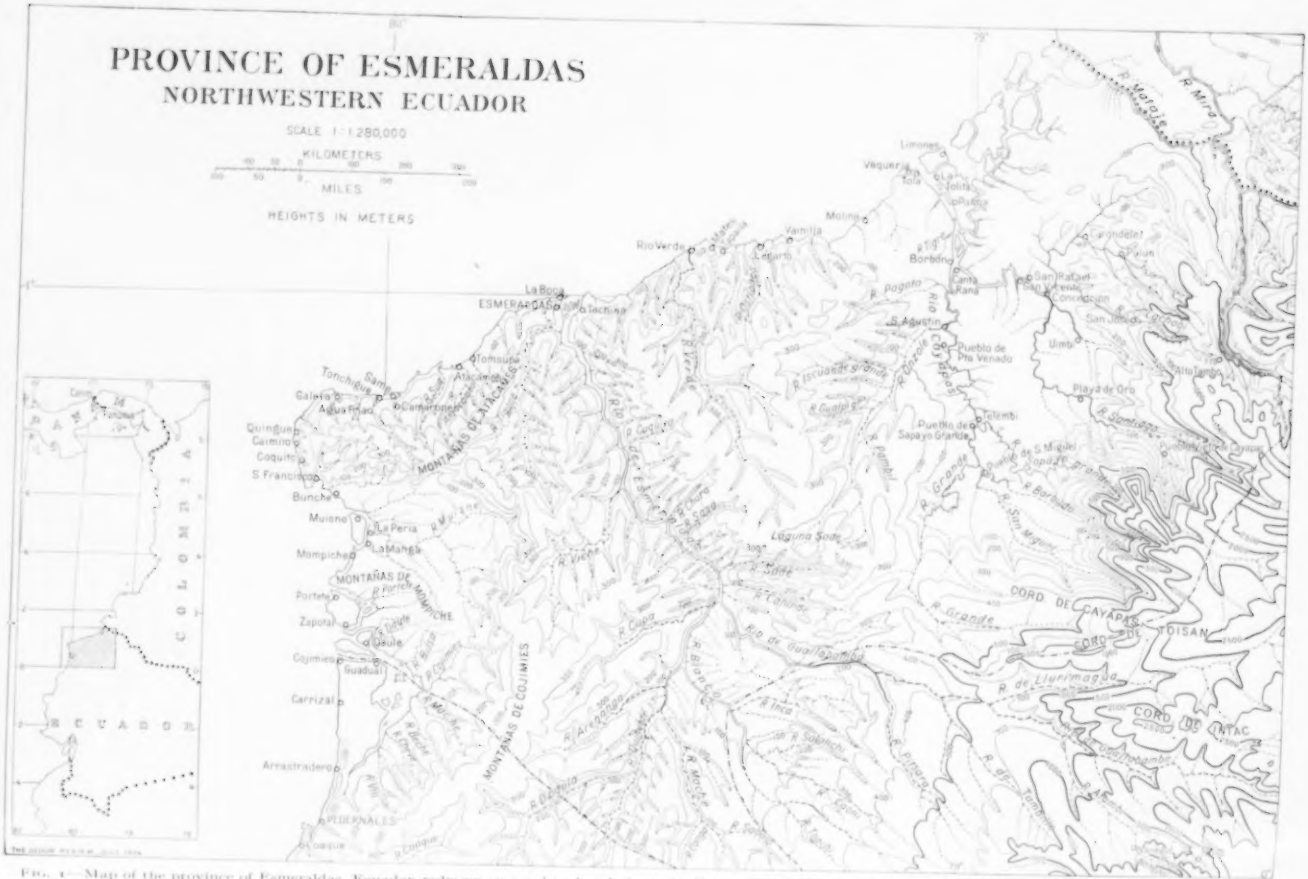
Some five hundred miles from Panama, on the Pacific Coast of South America, lies a region which may be considered a veritable paradise from the point of view of the beauty of its landscapes, the astonishing fertility of its soil, and its rich minerals. There flourished, in remote epochs, very advanced civilizations intimately related to those of Yucatan and Central America. Nevertheless the province of Esmeraldas is very little known. Although it is so short a distance from the Canal which unites the two oceans; although its coast was the first point of the vast Inca Empire to be trodden by the *conquistadores;* and although from that moment attention was attracted by the wealth of the country and reports of the famous emeralds to which this province owes its name, it remains to the present time one of the least familiar sections of the Republic of Ecuador.

The province of Esmeraldas is the northernmost one along the Ecuadorian coast. On the north is the recently demarcated international boundary with Colombia.[1] Eastward Esmeraldas marches with the Andean provinces of Imbabura and Pichincha, southward with the coastal province of Manabi. The area of Esmeraldas is reckoned at 5500 square miles. Of this the greater part is still unexplored. The small towns—taken together they have in all not more than 25,000 inhabitants—are situated on the coast or on the banks of the large navigable rivers, the only easy means of communication except for a few trails connecting some of the outlying settlements and villages. The extensive plains of the interior between the Rio Blanco and the Guallabamba, the mountainous regions between the Cayapas and Esmeraldas Rivers, the sources of the Rio Verde and the Santiago, and even other parts of the country nearer the coast but hidden under virgin forests remain unknown and for the most part uninhabited, and this in spite of the fact that the province of Esmeraldas has an ample coast line with inlets easy of access and that, as already stated, it is one of the richest and perhaps the most beautiful and splendidly dowered by nature of the Ecuadorian provinces.

Exuberance of the Vegetation and Its Causes

Differing from Manabi and part of Guayas where the vegetation, although most vigorous, loses its beauty in summer when woods and plains are parched by the heat of the tropical sun, the verdure in Esmeraldas is perennial. Furthermore, it extends as a single mantle from the slopes of

[1] The Colombia-Ecuador Boundary, *Geogr. Rev.*, Vol. 11, 1921, pp. 296–297, with map.


PROVINCE OF ESMERALDAS
NORTHWESTERN ECUADOR
SCALE 1 : 1,280,000
KILOMETERS
MILES
HEIGHTS IN METERS
COLOMBIA
ECUADOR
PACIFIC OCEAN
ESMERALDAS
La Boca
Tachina
Tonsupa
Atacames
Tonchigüe
Galera
Agua Blanca
Quinguimbi
Caimito
Coquito
S. Francisco
Bunche
Muisne
La Peria
La Mañana
Mompiche
Portete
Zapotal
Cojimies
Guadual
Carrizal
Arrastradero
PUERTONALES
MONTAÑAS DE ATACAMES
MONTAÑAS DE MOMPICHE
MONTAÑAS DE COJIMIES
Rio Verde
Vainilla
Molina
Vequería
Limones
Borbón
Santa Rana
S. Agustin
Pueblo de Dto Venado
Uimbi
Playa de Oro
Puerto de Sapayo Grande
Telembi
Laguna Sade
CORD DE CAYAPAS
CORD DE TOISAN
CORD DE NTAC
R. Mataje
R. Mira
R. Santiago
R. Grande
R. Cayapas
R. Guallupe
R. Blanco
R. Inta
R. Verde
R. Cuaca
R. Bogota
R. Borbón
R. Cachabi
R. Tululbi
R. Tululbi Grande
R. Tululbi Chico
R. Cholima
R. Tululbi Grande
R. Tululbi Chico
R. Cholima
R. Tululbi Grande
R. Tululbi Chico
R. Cholima

the Andean Cordillera to the shores of the Pacific. Its exuberance is prodigious. An immense variety of huge trees grow everywhere, and the creepers and parasites on them form veritable awnings. The royal palm and the coconut tree raise their crests to great heights in the midst of innumerable other trees of valuable wood, such as the cedar, the lignum vitae, and the oak, which cover large areas. There together with many species of rattans and canes grow the *pambil* which the inhabitants use for the construction of their houses; the *tagua*, or ivory palm, whose leaves, *cadi*, are used like those of the *bijao* for roofing and whose fruit, the vegetable ivory, constitutes one of the chief exports of the country, averaging 15,000,000 pounds a year; the rubber tree, which was discovered in Esmeraldas in the eighteenth century, and constitutes another great source of wealth;[2] the *toquilla* so valuable in industry (Panama hats); and the *tamajagua* of whose inner bark the Cayapas Indians make their clothing and their bedding. Cacao of high quality is grown, as are balsams, vanilla, copal gum, coffee, excellent tobacco, several different plantains,[3] and an immense variety of other fruits.

The wide plains of the coast only occasionally present the monotonous vegetation of mangrove thickets, flood plains, and marshes. Most of the pampas are covered by the most varied flora—bamboos, shade trees whose trunks are covered by thousands of orchids; and amidst this exuberant vegetation open wide coves with deep and gentle waters where fishing is excellent and boating easy and safe.

Steady Warmth and Constant Humidity

Temperature, humidity, chemical richness of the soil explain the prodigality of the vegetation. In Esmeraldas there are no altitudes like those in the interior of the republic sufficient to modify the tropical temperature which prevails throughout its extent. The climate is therefore hot, but the heat is much less intense than in the other coast provinces thanks to the continuous evaporation from the damp forests. On the seashore (Esmeraldas, Rio Verde, La Tola, Atacames) the temperature does not exceed 80° or 82° F., while in other coast provinces a rise to 91° or 93° is not unusual. In the interior the mean temperature is 72° to 74° and remains remarkably constant throughout the year. The only two seasons distinguishable on the coast are winter and summer, but with this peculiarity that in summer there is more humidity and rains are more frequent. As one proceeds eastward into the interior, along the foothills of the great

[2] In 1736 La Condamine sent to Europe the first samples of rubber, which was discovered in the province of Esmeraldas. He accompanied his shipment with a very interesting memorandum. A detailed account of the discovery of rubber is found in E. Chapel: Le caoutchouc et la gutta-percha, Paris, 1892, and in Henri Jumelle: Les plantes à caoutchouc et à gutta, Paris, 1903, pp. 4–7.

[3] "Their banks [of the Atacames and Sua Rivers] are covered with plantains of which there is no end, which were planted there in heathen times" (Pedro Maldonado: Noticias puntuales de las posesiones y distancias de la Ciudad de Quito, etc., MS. in the National Library of Quito, fol. 243).

See Luis Sodiro: Apuntes sobre la vegetación ecuatoriana, Quito, 1874.

Fig. 1.—Map of the province of Esmeraldas, Ecuador, redrawn on a reduced scale from the Esmeraldas-Galápagos sheet of the American Geographical Society's Millionth Map of Hispanic America. The inset shows the general situation of the province.

FIG. 2—The Mataje River, which in the lower part of its course forms the boundary between Ecuador and Colombia. (Photograph by M. H. Saville for the Mrs. Marie A. Heye Expedition.)

Cordillera, the difference of seasons tends more and more to disappear so that one may say that in this region there is only winter, that is to say the rainy season.

CONTRASTS WITH THE PERUVIAN COAST: INFLUENCE OF OCEAN CURRENTS

We have already remarked on the different aspect of Esmeraldas compared with that of Manabi and Guayas. A little farther south, on the Peruvian coast where it almost never rains, the contrast becomes extreme. The dryness of the Peruvian coast is to be ascribed in part to the cold Humboldt Current.[4] The significance of the difference between the atmospheric temperature and the sea here was pointed out by Wolf and contrasted with conditions in Ecuador.[5] He quotes Humboldt's figures for Callao, temperature of the sea 60°, and of the air 73°, whereas in Esmeraldas the temperature of the sea ranges from 82° to 84°, a degree or two higher than the atmospheric temperature.

The situation of Esmeraldas is extremely interesting in this respect. Two chief currents which follow opposite directions bathe the shores of Ecuador. The Humboldt Current, to which we have referred and which flows along the shores of Chile and Peru, at the latitude of Cape Blanco (4°20′ S.) divides into two arms, one of which follows the coast until near Cape Pasado (latitude 0°20′ S.), while the other turns toward the northwest and the Galápagos. The other principal current comes from the north and is a branch of the Mexican Current, which unites with the West Equatorial and just opposite the coast of Esmeraldas turns toward the west, mingling with the Equatorial Current of the Pacific. Its influence is felt

[4] For a discussion see Isaiah Bowman: The Andes of Southern Peru: Geographical Reconnaissance Along the Seventy-third Meridian, New York, 1916, pp. 125–127.

[5] Teodoro Wolf: Geografía y geología del Ecuador, Leipzig, 1892, p. 385. *Idem:* Apunte sobre el clima de las Islas Galápagos, *Bol. Observatorio Astronómico de Quito*, No. 3, 1879, p. 49. For recent observations on the Peruvian coast see R. C. Murphy: The Oceanography of the Peruvian Littoral with Reference to the Abundance and Distribution of Marine Life, *Geogr. Rev.*, Vol. 13, 1923, pp. 64–85.

FIG. 3—The Mataje River. View from the Colombian side. This forms a panorama with Figure 2. (Photograph by M. H. Saville for the Mrs. Marie A. Heye Expedition.)

in the zone we are studying, especially in the bay of Ancon de Sardinas, which Villavicencio says "is noteworthy for its many currents.[6]

Reference must here be made to another influence of ocean currents of great geographical importance—their effect on the movements of peoples. The influence of wind and currents in the distribution of peoples in the South Seas, for instance, is well known and often described. This same factor should be taken note of in investigating the origin of the primitive inhabitants of Ecuador and their cultural relations. Thus, the province of Esmeraldas lies between two important maritime routes which put it in communication with other regions of the American continent. That part of the coast running from northeast to southwest between the Ancon de Sardinas and Cape San Francisco receives warm waters which bathe the lands of the north, the same that wash the shores where flourished the civilizations of the Nahuas, Tarascos, Mixtecas, Zapotecas, and the Central American cultures. The coast between Cape San Francisco and the province of Manabi, whose general direction is from north to south, feels the last influence of the Humboldt Current.[7] Thanks to this current, boats from the Peruvian coast and from all the Ecuadorian coast to the south of the equator have always been able to reach Esmeraldas without great difficulty, as it is certain they did at the time of the Spanish Conquest. Their return southward was facilitated by the north winds.[8]

[6] Manuel Villavicencio: Geografía de la República del Ecuador, New York, 1858. Cf. Antonio de Alcedo: Diccionario geográfico-histórico de las Indias Occidentales ó América, 5 vols., Madrid, 1786–89; reference in Vol. 1, p. 92, Ancon de Sardinas.

[7] See Andrés Baleato: La Ciudad de Panama y su distrito, puerto, producciones, y historia, in Colección de documentos, inéditos sobre la geogr. e hist. de Colombia, compiled by A. B. Cuervo, Bogotá, 1892, Vol. 2, p. 347. "From the year 1736 the general direction [of currents] has been known, for ordinarily at the time of the north winds, from Morro de Puercos to the latitude of Malpelo, they flow southwest and west. From the latitude of Malpelo to Cape San Francisco to the east and east-southeast, turning towards Gorgona. From Cape San Francisco they go to the south and southwest until 30 or 40 leagues offshore, and according as the wind is stronger or lighter the movement of the water is more or less rapid. During southerly gales from Point Santa Elena to Cape San Francisco they are north and northwest as far as 30 or 40 leagues out to sea."

[8] "And I saw coming from the shore of the sea a boat which was of great size, which seemed a lateen sail . . . in the which came as many as twenty persons, men, women, and children" (G. F. de Oviedo y Valdés: Historia general y natural de las Indias, 4 vols., Madrid, 1851–55; reference in Vol. 4, Book 43, Ch. 3, p. 121).

The Santiago River in the northern part of the province and the Esmeraldas River in the southern part constitute with their great number of tributaries the two most important hydrographic systems.

The Santiago System and the Cayapas Indians

The Santiago system comprehends four principal rivers, the Cayapas, the Santiago, the Cachabi, and the Bogotá. The Cayapas rises in the mountain range of the same name and in the Toisan range, through a deep gorge of which it plunges toward the plains. Being navigable for a great distance, it is often traversed by the canoes of the Cayapas Indians who live along this river and its principal tributaries. These include the Onzole, almost as large as the Cayapas itself, and the Rio Grande. The Onzole rises near the Sade lagoon, on the watershed between the Esmeraldas and the Santiago Rivers, and drains a great part of the interior. At its mouth, one league from the Santiago, are found the first habitations of the Cayapas. The banks of the Rio Grande, which empties near the village of San Miguel de Cayapas, are populated by these Indians. This is the most interesting ethnographic region for the study of the remains of the Cayapas nation, whose origin and ethnical relations are still obscure. A knowledge of this nation would doubtless throw an immense light on the ancient ethnography of Esmeraldas and the series of civilizations that succeeded one another within its territory.

The Great Sapayo and the Barbudo, the chief tributaries of the Cayapas on the right, are particularly rich in gold. By the latter the Cayapas Indians occasionally travel to the Pinan *páramos* in Imbabura; and this route must be considered one of the means of communication between the seat of Imbabura civilization and that of the mountain peoples of Esmeraldas.

The delightful valleys of the rivers named must formerly have been much more thickly populated, to judge from the remains still existing and from the accounts of the chroniclers and early explorers. Dr. Wolf in 1879 estimated the number of Cayapas inhabiting the banks of these rivers to be between two and three thousand,[9] but there is no doubt that the population has decreased since the time of the Conquest. Even this estimate is larger than that of Don Pedro Maldonado, who speaks of some sixty families, although this may perhaps refer only to those living in the village of Cayapas or San Miguel.[10] But far more noteworthy has been the almost total disappearance of the native populations which formerly lived near the sea. The early chroniclers speak of large tribes dwelling there. Xerez says that there were large settlements with three thousand houses. "And the ships coming from the sea reached the bay of San Mateo

[9] Teodoro Wolf: Viajes científicos por la República del Ecuador, 3 vols., Guayaquil, 1879; reference in Vol. 3, p. 52.

[10] Maldonado, *op. cit.*, folios 245 *et seq.*

and some villages to which the Spaniards gave the name of Santiago, and the villages of Lacamez . . . which were large and of many and warlike people, for when the Spaniards came within a league of the village in these Lacamez settlements, there came out to meet them more than ten thousand Indian warriors" . . . "village had more than three thousand houses and there were other smaller ones."[11] Dampier even in 1684 found the coast of Esmeraldas thickly inhabited.[12] In 1803 Caldas already laments the disappearance of the populations of Lachas, Puntel, La Tola, and Limones. "We know," he says, "that the mass of population always increases in all parts of the world; why do we find a decrease only among the Indians?"[13]

The destruction of the Indian settlements located in the region lying at the base of the Andes has been attributed to a terrible volcanic eruption,[14] but we believe that this depopulation can be attributed to causes in common operation among primitive civilizations—waves of immigrants arriving in different epochs and destroying the existing settlements or forcing their inhabitants to move to other regions, and continual wars with other tribes and settlements. Whatever the cause, the fact is that immense territories once thickly inhabited are today completely deserted and that only a few miserable villages are left of settlements that were formerly centers of the most advanced civilization developed on the Pacific coast between Central America and Peru.

The Santiago River is navigable for only a few leagues above its junction with the Cayapas; unlike that stream it is a torrent throughout almost the whole of its upper reaches, and its bed at times is constricted. Two leagues above Playa de Oro it is impassable for any sort of boat, since it runs through a narrow canyon with almost vertical walls several hundred feet high. Above them rise the buttresses of the Pinan and Lachas ranges, which are among the least known sections of the province. The few families of Cayapas Indians living on the upper part of the river communicate overland or by the Great Sapayo and Barbudo Rivers with the other little settlements of the tribe. They never descend the Santiago, the middle and lower reaches of which are today populated by some negro families.

Flowing practically parallel with the Santiago and separated from it by a series of low hills is the Cachabi. Like the Santiago, it has a tortuous course and rapid current. It is subject to marked variation in flow, rising sometimes to an extraordinary height as a result of thaws in the Cordillera

[11] Francisco de Xerez: Veradera relación de la conquista del Perú y province del Cuzco, in Biblioteca de autores españoles, Vol. 26 (Historiadores primitivos de Indias, Vol. 2), Madrid, 1862, pp. 319–346; reference on p. 321. Cf. Oviedo, *op. cit.*, Vol. 4, Book 43, Ch. 3, p. 123. (Oviedo says "Catamez.")

[12] William Dampier: New Voyage Round the World, London, 1698, Ch. 7.

[13] F. J. de Caldas y Tenorio: Viaje de Quito á las costas del Océano Pacífico, por Malbucho, hecho en Julio y Agosto de 1803, in Obras de Caldas (Biblioteca de historia nacional, Vol. 9), Bogotá, 1912, pp. 107–125; reference on p. 123.

[14] "It [the Pichincha] was said to have erupted in the direction of the land of the Yumbos de Guerra Indians, and buried villages and killed many people among them" (Salazar de Villasante: Relación general de las poblaciones, espagñolas del Peru, pp. 1–41 in Vol. 1 of "Relaciones geográficas de Indias, Perú," 4 vols., Madrid, 1881; reference on p. 27).

FIG. 4

FIG. 5

FIG. 6

FIG. 4—The town hall and plaza, City of Esmeraldas.
FIG. 5—The mouth of the Rio Verde.
FIG. 6—The beach that forms the only highway on the coast between La Tola and Rio Verde. (Photographs by M. H. Saville for the Mrs. Marie A. Heye Expedition.)

FIG. 7

FIG. 8

FIG. 9

FIG. 7—The hacienda of Pampa de Oro, La Tolita (delta of the Rio Santiago).
FIG. 8—Tolas, artificial mounds, at La Tolita.
FIG. 9—Cayapas Indians on the Rio Santiago. (Photographs by M. H. Saville for the Mrs. Marie A. Heye Expedition.)

and at other times falling so much that the inhabitants along the banks have to drag their canoes across bars of sand and gravel. The Bogotá unites with the Cachabi a short distance above its junction with the Santiago half a league above the town of La Concepción. This stream, which rises in the plains of the northeast of the province, is deep and gentle, lending itself to navigation by boats and barges.

Below La Concepción, the Santiago is a broad, deep, and majestic stream until, divided into many branches and leaving a great number of islands in its midst, it empties into the ocean. The chief of the islands in the delta of the Santiago are La Tola, Santa Rosa, and San Pedro—all very important from the archeological point of view.

Throughout the greater part of the basin auriferous deposits are found. In these washings the gold is found mixed with platinum and small amounts of osmium, iridium, palladium, and rhodium—a circumstance worthy of notice because analysis of many antique gold objects found in this region has given the same results as that of samples from the washings on the Santiago. The same has been observed in the analysis of platinum objects and of the remarkable alloys of gold and silver with this metal, which was unknown in Europe before the eighteenth century.[15] This proves that the interesting objects found in the graves of the Esmeraldean coast were made by the aborigines and not acquired through commerce with other civilized countries.

The Esmeraldas Basin

Towards the south of the province we find the second river system whose great artery is the Esmeraldas River. Differing from the Santiago by the extensive ramifications that make this system the greatest of those on the Pacific slope of the Republic, it differs no less in the character of the region drained. Whereas the entire lower basin of the Santiago lies in Pleistocene and recent deposits, much of the Esmeraldas basin is developed in Tertiary formations, and a part of the Esmeraldas and Guallabamba valleys is occupied by a volcanic tufa, which evidently originated in the inter-Andean volcanoes in post-Pleistocene time. In the snows of the Andean Cordillera are found the sources of this system, whose principal branches are the Blanco and the Guallabamba. The Rio Blanco rises on the western slopes of the Pichincha. In the mountainous and almost unexplored region of its upper reaches it receives the waters of the Toachi River, which comes from the high mountains to the west of Latacunga and Machachi, and of the Yambe, whose source has not been explored. Farther on the Caoni enters from the right. This region, in which there are many ruined fortifications and archeologic remains, deserves a careful study; unfortunately it is as yet almost unknown. From the entry of the Caoni on, the Blanco

[15] A proof of the great progress made by the Esmeraldeans in the art of working metals is the different alloys with platinum. Wolf says in this connection: "I have never seen such a variety in shades of gold, from the lightest to the darkest, and certain mixtures surprised me especially because I do not believe that they have previously been observed in American antiquities" (Wolf, Viajes cientificos, Vol. 3, pp. 50–51).

has a broad valley; its channel widens considerably and frequently divides into arms which surround picturesque islands. The principal tributary of the Blanco, the Quininde, comes from the south through a somewhat narrow but deep channel favorable to navigation and one which must formerly have served as a means of communication between the settlements of the interior and the coast provinces.

FIG. 10—The Rio Atacames near the town of Atacames. (Photograph by M. H. Saville for the Mrs. Marie A. Heye Expedition.)

The region traversed by the Blanco is beautiful and is rich in fine woods, rubber trees, and ivory palms. With its tributaries, also navigable, the system constitutes the easiest means of communication between the interior of this province and the mountains of Manabi and Santo Domingo. These latter are the abode of another important tribe of Indians, known as the Colorados. From their language and ethnical characteristics we must consider the Colorados closely related to the Cayapas.

The Guallabamba gathers all the waters of the inter-Andean valley in the province of Pichincha and opens a path to the west through the gorges of the Puellaro, Perucho, and Niebli. At the base of the Andes the current remains very rapid, and along the winding channel in this part of its course may be seen many little barren islands of gravel supporting only a straggling vegetation.

Rather more than 40 miles from the sea the Rio Blanco and the Guallabamba unite under the name of Esmeraldas. The great river at this point again enters a mountainous region extending without interruption to the coast, and the basin is correspondingly narrowed. Its banks present the most varied aspects as hills and ridges follow each other in quick succession. The Esmeraldas does not form a delta like the Santiago, but in its wide mouth islands and shoals are formed whose shape and location the swift current is continually altering.

For a distance of 125 kilometers the coast on both sides of the river's mouth consists for the most part of rocky declivities and in many places of high cliffs, broken here and there by the ravines of rivers which have their source in the low-lying regions near the coast or in the mountains of the southernmost part of the province.

Rivers of the Littoral

The principal rivers of the littoral district, beginning from the south, are first, the Cojimies, a river system of some importance with its multitude of little tributaries which rise in the Cheve, Mache, Cojimies, and Mompiche Mountains. These ranges surround the wide plain in the center of which lies the Gulf of Cojimies. The shores of the gulf were formerly inhabited by a numerous people with an art differing in some respects from that of the aborigines of La Tola. Northward is the basin drained by the winding Muisne and its tributaries and bounded to the north by the Atacames Mountains. The coast of these two valleys, which are separated by the Mompiche Mountains, is low, and at the mouth of the rivers we have just named are islands and sandbanks similar to those of La Tola.

From Cape San Francisco on, the coast, as we have said, is high and rocky. Between this sort of rampart and the sea is a sandy beach along which one may pass at low tide. Further on we find the Atacames River, near the mouth of which lies the ancient and once important settlement of the same name. The Atacames region has a special archeological importance. Between the Esmeraldas and the Santiago and almost parallel with the former flows the Rio Verde, the largest of the so-called littoral rivers. Finally, north of the Santiago the Mataje River empties into Ancon de Sardinas Bay in the northern part of a labyrinth of inlets that form the end of the low plain of San Lorenzo and La Tola.

Prehistoric Remains in the Coastal Region

Traces of ancient peoples are found along the whole coast of Esmeraldas and especially near the mouths of the rivers. "In many places," says Señor Portes in a memorandum addressed to the government in 1837, "for league upon league the ground is covered with pots, jars, and grotesque figures of colored clay, some whole, some broken. The farmer's wooden shovel is continually striking against buried jars which contain

human skeletons, axes of hard stone, chiseled with the delicacy of a modern lapidary, stilettos and other implements of copper, as hard and perfect as the steel ones in use today, although of a different type."[16] Real banks of fragments of pottery mingled with human remains, ashes, and shells are found in many places both in the region bounded by ravines and high rocks and in the other which is covered in part by thickets of mangrove trees and which includes a multitude of channels and islands. Of all these deposits, only a few have as yet been studied. At the mouth of the Tomsupa River, five miles north of Atacames, there is a great mound of fragments of pottery and pieces of jars among which are found many gold and platinum objects. In Tonchigue, fifteen miles south of Tomsupa, the expedition led by Professor Saville found a layer of pottery twenty inches thick and four hundred feet long.[17] On the right bank of the Atacames the floods of the river have laid bare another great bank containing an enormous deposit of human remains, great jars, pots, and tubes of clay.[18] Dr. Wolf found thread, wire, and little plaques of gold and alloys of this metal with others in a ravine a little south of the site of Lagarto, east of Punta Verde.[19]

Generally all these objects are found at no great depth beneath the surface and in soil of modern alluvial formation. In the few cases where they are found at a considerable depth or under the sea or resting on soil of tertiary marine formation, it is due to the redistribution of the material by sea and rivers. These processes are helped by a slight degree of subsidence in progress, but much more important are the ordinary processes of erosion. In the memorandum of Señor Portes, quoted by Ceballos, we read: "From the inroads which the sea has made during the six years I have lived here, one may notice that during the last century it has usurped some 400 rods of the coast. There are residents of La Tola who remember having seen houses where boats now anchor, and it is probable that this village itself will disappear in a few years because it is easy to observe how much the sea is eating into it."[20]

Theories attributing a great antiquity to these deposits of pottery and human remains are very questionable. The soil itself of the northern beaches where these archeological objects are found is very modern, and at this day the configuration of some of the islands and points at the river mouths is constantly changing. The archeologist should keep geological phenomena well in mind while studying the various deposits of objects that reveal the existence of prehistoric man. A great number of terra cotta vases and human and animal figures, stone implements, and metal ornaments are also found in the artificial mounds abounding in the northern part of Esmeraldas.

[16] P. F. Ceballos: Resumen de la Historia del Ecuador, Guayaquil, 1889, Vol. 6, p. 184.

[17] M. H. Saville: Archaeological Researches on the Coast of Esmeraldas, Ecuador. *Verhandl. des XVI. Internatl. Amerikanisten-Kongresses, Wien, 9. bis 14. Sept., 1908*, Vienna and Leipzig, 1910, pp. 331–345, reference on p. 337.

[18] *Ibid.*, pp. 337–338.

[19] Wolf, Viajes cientificos, Vol. 3, p. 50.

[20] Ceballos, *op. cit.*, Vol. 6, p. 186

The environs of La Tola, the island of the same name, and above all the island of Santa Rosa, where La Tolita is situated, are extremely rich fields for the archeologist and contain abundant material for study.

This name of La Tola is due in reality to the structures raised by the aborigines and called "tolas," artificial hillocks similar to the "mounds" of North America and like them of varying dimensions and forms, the most common being the conical, or hemispherical, and the rectangular in outline.

These hillocks abound in that region and are found along almost the whole of the Ecuadorian coast. In the interior the region of the mounds is confined to the province of Imbabura and a part of Pichincha,[21] but these mounds differ in many respects from the earth and stone structures of Manabi and Esmeraldas.[22]

Relation with Other Civilizations

What was the relation between the mound builders of the Imbabura region and those of the coast? Does the difference in the art, which indicates two entirely different civilizations, mean also an essential difference in the origin of these peoples? What was the relation of the mound builders of Ecuador to the Chibcha peoples, to whose linguistic stem must be referred many of the geographical names of the region in which these monuments are found and the Cuaiquer, Cayapas, and Colorado languages? In the indubitable succession of civilizations and immigrations that occurred in the province of Esmeraldas, to which one may we attribute the introduction of this type of structure, and what place belongs to the Cayapas?

To the Atacames or Esmeraldeans of the coast Buchwald attributes the mounds of Samborondon between Guayaquil and Babahoyo and others in the province of Los Rios.[23] What was the ethnographic extent of this people whose progress in the arts, especially in pottery, is so surprising? These are problems of the greatest importance for Ecuadorian prehistory, and we hope they will gradually be solved.

The greater part of the vast and beautiful territory of Esmeraldas is arable, and the exuberance of the vegetation everywhere proves the fertility of the soil. The aborigines therefore were able to obtain with little trouble and in great abundance the elements necessary to sustain life. But this same facility bestowed so prodigally on them by nature hampered the development of certain arts and industries. Thus we shall seek in vain in Esmeraldas for the remarkable works for the cultivation of the fields that were accomplished in pre-Columbian epochs in the arid coasts of Peru.

[21] Cf. Federico González Suárez: Los aborigines de Imbabura y del Carchi, 2 vols., text and atlas, Quito, 1908, 1910, reference in text, p. 11; *Notas Arqueologicas*, Quito, No. 8, p. 73, No. 10, p. 114; Jacinto Jijón y Caamãno: Contribución al conocimiento de los aborigines de la provincia de Imbabura en la República del Ecuador (Estudios de prehistoria americana, Vol. 2). Madrid, 1912, p. 298.

[22] See C. M. Larrea: Otto von Buchwald—Tolas ecuatorianas, *Bol. Soc. Ecuat. de Estudios Historicos Americanos*, Vol. 1, 1918, pp. 64-69. In this article the author names the principal works dealing with the Ecuadorian mounds.

[23] Otto von Buchwald: Tolas ecuatorianas, Buenos Aires, 1917, p. 8.

Neither are there irrigation canals, since the humidity is excessive; nor shelves and terraces, since the plains are immense and the undulations of the ground gentle; nor causeways and roads, because the navigable rivers offered quicker and easier transportation. On the other hand the fishing industry must have been very well developed; remarkably perfect boats were built; and the arts of pottery and metallurgy were far advanced in the period when the coast peoples flourished. The hot climate was doubtless one reason why the textile arts did not reach a high stage of perfection, but the use of ornaments and jewels, beautifully wrought, was very common.

At the present time the cities of the coast enjoy the advantages of civilization and modern progress. The capital of the province, also called Esmeraldas, is a picturesque port which is united with the rest of the world by cable and wireless, but toward the interior there still remain the unexplored solitudes of the forests among which flow copious rivers carrying grains of gold and platinum.

ROCK CREEP ON MT. KTAADN, MAINE

By Edward S. C. Smith and Philip W. K. Sweet

Mt. Ktaadn is situated nearly at the geographic center of the State of Maine in Piscataquis County in a practically uninhabited region. As it is thirty miles from the railroad and difficult of approach, to make a protracted stay at the mountain one must be prepared to rough it with the camping equipment that may be packed in on horseback. Recently, however, lumbering operations have reduced the distance over which pack methods must be employed.

No good topographic map of Ktaadn has yet been made, but the broader features are shown on the hachure map (Fig. 1) which accompanies this paper. As seen from the south (Fig. 2) the mountain rises abruptly from a general level not exceeding a few hundred to 5273 feet above the sea. On the northeast, north, and northwest appear other mountain groups such as Turner Mountain, Wissataquoik Mountain, Mt. O J I, and others, though none of these compare in height or extent with Ktaadn. At only short distances either side of the mountain flow the east and west branches of the Penobscot River, both of which were used as avenues of approach to it in the early days and still are favorite routes.

Early Ascents

Numerous excursions took place in those earlier days, and there is much of historical interest attaching to Ktaadn in this connection. In fact, a volume might be written concerning those pioneer ascents, and it may be well to review some of the outstanding ones. The earliest recorded ascent of the mountain was made in 1804 by Charles Turner, Jr., and party. Turner was engaged in his duties as a land surveyor. It appears that the Indians of the vicinity, Penobscots and Abnakis, believed the mountain the lair of an evil spirit whom they called Pamola; and never would an Indian ascend higher than the tree limit for fear of this monster. Nevertheless, the Indian guides of Turner's party went to the top, apparently willingly, after they found the white men determined to go. The name Pamola is at present applied to one of the lesser peaks of Ktaadn.

During the northeastern boundary controversy we find that the mountain was ascended in 1819 by Colin Campbell, one of the surveyors employed by the British Government. In 1836 Professor J. W. Bailey of West Point and Professors Keely and Barnes of Waterville (now Colby) College visited the mountain. The following year Dr. Charles T. Jackson with a party climbed Ktaadn in a snowstorm while performing his duties as first State Geologist of Maine. In 1847 an ascent was made by the Rev. Marcus

R. Keep, Home Missionary in Aroostook. A born naturalist with a great love for the out of doors, he neglected no opportunity to further his knowledge of the wilderness in which he found himself placed, and his name will always be linked with Ktaadn. It was he who accompanied Charles H. Hitchcock about Ktaadn in 1861 at the time of the second geological sur-

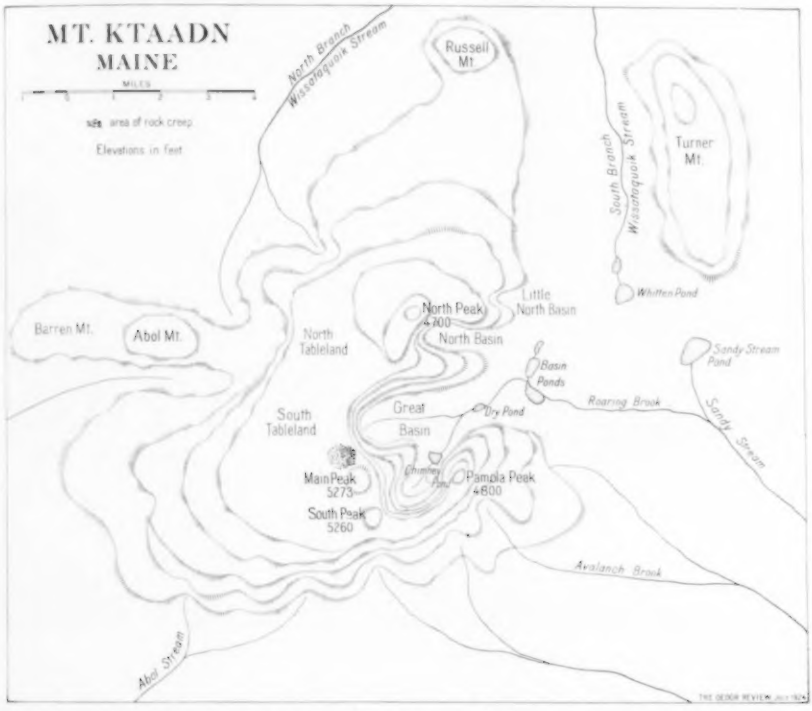


FIG. 1—Map of Mt. Ktaadn showing position of the area of rock creep and other general features.

vey of the state. In the summers of 1873 and 1874 Merritt C. Fernald, at one time President of the University of Maine, made expeditions to Ktaadn which resulted in the first reliable determination of its height, previously believed to be much over one mile. Fernald's determinations gave about 5215 feet as the altitude. Subsequent measurements show the true elevation as 5273 feet.

TOPOGRAPHY OF THE MOUNTAIN

It was the privilege of the writers to visit this region in August, 1923, and carry out a study of the bed rock geology already contemplated for several years. At the same time observations were made upon the rock creep which is taking place over a large area on the upper portions of the mountain. As this phenomenon is not one which may be said to be of com-

mon occurrence, this opportunity is taken to present the facts in brief form.

As both C. E. Hamlin[1] and R. S. Tarr[2] have given excellent descriptions of the topography of the mountain, it will be sufficient to say here that Mt. Ktaadn may be considered as a part of a great granite batholith which has been only slightly dissected into the several mountain groups mentioned above; Ktaadn itself remains as the largest mass. The mountain has suffered erosion by ancient valley glaciers as well as from the last con-

FIG. 2—Mt. Ktaadn from the south. (Photograph by Call, Dexter, Me.)

tinental ice sheet. At the present time streams are in a limited way assisting in dissection, and the atmospheric agencies are very active. Both mechanical and chemical weathering are proceeding rapidly.

Glaciers and streams have carved a number of spurs running out from the main portion of the mountain, the so-called table-land whose elevation is about 4300 feet. From this table-land the upper slopes to the various peaks are relatively gentle, probably about 1500 feet to the mile as an estimate in absence of instrumental determinations.

ROCK CREEP AND ITS CAUSE

It is upon the slope on the northern side of the main peak that an example of rock creep such as is peculiar to semiarctic regions is to be seen.

[1] C. E. Hamlin: Observations Upon the Physical Geography and Geology of Mount Ktaadn, and the Adjacent District, *Bull. Museum of Comp. Zoöl. at Harvard College*, Vol. 7 (Geol. Series, Vol. 1), 1880–84, pp. 189–224.

[2] R. S. Tarr: Glaciation of Mount Ktaadn, Maine, *Bull. Geol. Soc. of America*, Vol. 11, 1900, pp. 433–448.

FIG. 3

FIG. 4

FIG. 3—"The Knife Edge," the upper walls of the Chimney Pond cirque. (Photograph by Call, Dexter, Me.)

FIG. 4—General view of the slope on which the principal creep is taking place. (Photograph copyrighted by W. F. Dawson, Lynn, Mass.)

Here an area some acres in extent is covered with a mantle of rock of this nature. Essentially all the material has resulted from the disruption of the Ktaadn granite along its joint planes and is well sorted; the larger and more massive fragments are found nearer the summit and source of the rock, the smaller farther down the slope. Passing downward, the rock fragments are seen to become distinctly subangular and in rare cases actually rounded. The condition of subangularity is less apparent towards their source. Certain parts of the mass tend to radiate tongue-like and resemble a rock flow. One of these tongues is especially prominent and extends for thirty or forty feet. Occasionally it is possible to see the rock fragments a foot or so deep far down the slope; and, thinning radially, they thus approach the true rock flow. Such observations make it quite evident that there has been a movement down grade under the influence of gravity which has resulted in reciprocal abrasion and rude sorting.

It is well known that in mountainous regions where a considerable degree of cold prevails for the greater part of the year rock creep or flowage may go on at such a rapid rate that vegetation of any kind is prevented from gaining a foothold. Such conditions obtain in certain parts of the Ktaadn rock flow. The creep, or flow, is due primarily to the action of the frost which forms underneath boulders or pebbles. The expansive force of the freezing water lifts the rock a small but definite distance from the ground. As this lift is in a direction at right angles to the inclination of the surface on which the fragment rests, and the eventual melting of the ice crystals allows gravity to act in the true vertical, the boulder or pebble is thus advanced forward and down the given slope. This action repeated many times will serve to transport fragments of even considerable size long distances provided the angle of depression remains sufficiently sharp.

The rock flow examined occurs, as we have said, on the north-facing side of the main peak, exposed to cold winds and frost for the greater part of the year. In addition, a wide daily range of temperature obtains in all seasons and aids very materially in the disintegration of the granite. Actual observations of temperature differences on the main summit between sun and shade at noon in September have shown fifty Fahrenheit degrees.

The granite of the upper sections of the mountain shows three well developed sets of joints nearly at right angles to one another, which results in the formation of rectangular, sometimes cubical, joint blocks and offers an excellent opportunity for frost work. It is probable that during the late fall and early spring, when alternations of freezing and thawing go on apace, the larger prisms are detached from the parent ledge. Such an effect is to be observed on a grand scale at the upper walls of the cirque at Chimney Pond and has been referred to by Tarr in another connection. No doubt the blocks are often temporarily held in a position of instability awaiting only the melting of the ice to allow gravity free play. It is not difficult to imagine that, in the course of freezing and thawing, a not inconsiderable movement of such blocks will take place and, having once

started, will tend to keep in motion. The larger and more angular pieces will be moved only slowly at first: however, exfoliate weathering occurs to some extent, and, as their contours become more rounded, transportation takes place without much difficulty. Further, the slight mutual concussions tend towards the same end, thus making for a greater ease of movement. The rate at which fresh material is being added to the Ktaadn rock flow is now much slower than it must have been formerly, and the chief interest at the present time is centered not in the derivation of this material so much as in its downward sweep across the slope.

In a region which has had a fair share of valley as well as continental glaciers, it is only pertinent to consider whether or not such a deposit as above described might be explained on the basis of glacial action. That we are not dealing with the phenomena of valley glaciers is quite obvious because of the location of the materials, and it is also difficult to understand how an otherwise impartial continental ice sheet should have failed to make other similar deposits elsewhere about the table-land where the granite was equally available for attack. Further, it is generally conceded that the transporting power of the continental glacier was considerably reduced as it rode over the tops of mountains as high as Ktaadn. The material lacks the characteristics of any sort of moraine. Finally one may ask why, under glacial conditions, the rock fragments would be noticeably larger in the direction away from that in which the ice moved. Actual proof of flowage is found beside a few of the larger boulders where streams, if we may use the term, of rock have swept around them or in rare instances have been pushed up on them. Several cases of larger fragments being buried by the smaller ones were noted.

In conclusion, it is believed that the rock mantle described has resulted from the disintegration and subsequent creep down grade of joint blocks and their autoclastic derivatives, that it is post-Pleistocene in age, and that the chief activity now is the creep or flow of the more or less rounded boulders, pebbles, and coarse gravel.

It is believed also that the condition described is rare, perhaps unique for New England; no others are known to have been described from the higher mountains of that region.

THE ECONOMIC ACTIVITIES OF THE FALKLAND ISLANDS

By Clarence F. Jones
Clark University

The Falkland Islands, lying far down in the South Atlantic, 1000 miles south of Montevideo and 480 miles northeast of Cape Horn, are a frontier station of the habitable world. Here many South Polar expeditions have made their last stop and stocked up with provisions before the final dash for Antarctica and lands unknown. The islands constitute one of the more isolated places of the world; their communication with the outside depends upon steamers which call once a month on the outward and homeward passage between the United Kingdom and the west coast of Chile and Punta Arenas. On the other hand they occupy a significant location as the only oceanic way station relatively near the Magellan Strait route.

Settlement of the Islands

The first recorded discovery of the Falklands was by Davis in 1592, and the islands were visited by Hawkins two years later. However, it was not until the mid-eighteenth century that an interest in their strategic location was manifested. In 1764 France took possession of them, but two years later she sold them to Spain who valued them as a possible victualing station for her vessels bound for Peru and Chile. The Spanish founded a fort on East Falkland. Simultaneously the English formed a settlement on West Falkland. In 1770 the Spaniards dislodged the small English garrison. Restitution was made by Spain the following year, but active occupation ceased shortly. Subsequently the Spanish settlement was abandoned too. It was revived in 1820 by the young republic of Buenos Aires only to be broken up by an American ship of war in a controversy over seal fisheries rights in 1831. In 1832 Great Britain took final possession of the group, planted settlements, and in 1843 organized a crown colony here. Among the arguments set forth and accepted, when this step was under consideration, were the advantages that would accrue to British merchant shipping plying round Cape Horn and to the South American Squadron of the Royal Navy operating on either side of South America. The recent war proved the soundness of the reasoning, even for modern conditions, and emphasized the strategic character of the islands and the value of Stanley Harbor as a place of refuge, an excellent naval base, and an outpost of the Pacific. The latest stage in the political development of the colony was the creation of the Falkland Islands Dependencies by Letters Patent in 1908 and 1917.[1] This is the

[1] Compare the creation of the Ross Dependency, *Geogr. Rev.*, Vol. 14, 1924, pp. 314–315.

Antarctic sector comprising the islands and territories between 20° and 50° W. longitude south of 50° S. latitude and between 50° and 80° W. longitude south of 58° S. latitude (see Fig. 1), notably including South Georgia, the South Orkneys, the South Shetlands, the Sandwich Islands, and Graham Land.

The Falkland Islands, consisting of two large islands, East and West Falkland, and approximately one hundred smaller ones, comprise an

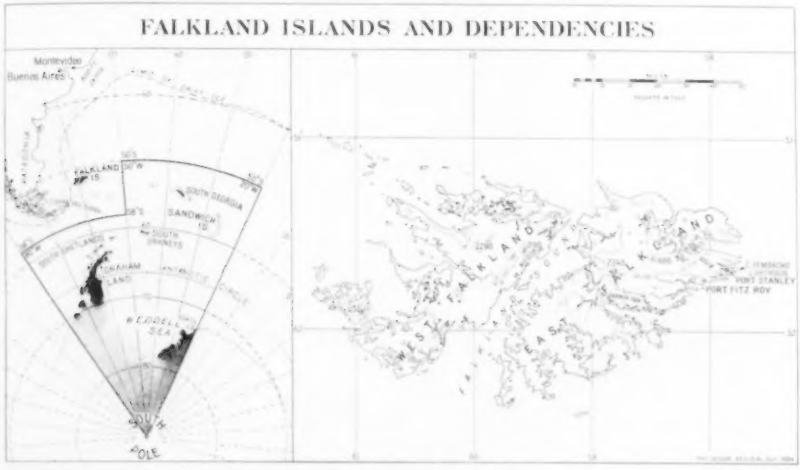


FIG. 1—The Falkland Islands and Dependencies. The larger map shows the Islands on the scale of 1:4,000,000 approximately. The smaller map shows the Dependencies (the "islands and territories" included within the sector bounded by the heavy line) in relation to the Islands.

area of 6500 square miles. They are therefore about the size of the Hawaiian group; but, whereas the balmy tropical air and fertile lava soils of those modern Islands of the Blessed support a population of a quarter of a million, the Falklands give poor subsistence to a scant population of 2300 souls. Seen as a whole, the major islands may be described as bleak, treeless, rolling moorland interspersed with gray rock ridges or jagged hills, which here and there rise to the height of 2000 feet or more (Fig. 1). In some places peat bogs and swamps are extensive while in others, where sheep have destroyed the grass, drifting sand adds the final touch of desolation. The peaty soils and the cool climate favor the growth of a coarse grass fairly well suited for sheep.

THE SHEEP INDUSTRY

For many years the principal industry, sheep raising now engages the attention of two-thirds of all the people on the islands. Almost the whole country is parceled out into farms or sheep runs, which are held by some thirty farmers and farm companies. The carrying capacity of the range

is relatively small, and the ranches are correspondingly large, varying from 1500 to 700,000 acres. A very large one grazes 200,000 sheep. Not all of the land, however, is suitable for grazing purposes. In total only two-thirds of 2,325,000 acres is in pasturage.

Other conditions influence directly the type of sheep raised. The ground is never dry and subjects the sheep to the foot rot disease, which is fatal to most breeds. Further adaptation is necessitated because of the climate.[2] The Falkland Islands lie in a belt of extraordinarily persistent storminess. One cyclone follows another in quick succession, the usual summer "let up" of the westerlies belt in the northern hemisphere being unknown. The amount of sunshine is small. Rain falls on more than 243 days of the year with maximum in summer and autumn, though the annual rainfall barely exceeds 20 inches, for most of the rain comes as mist and drizzle and light showers. The relative humidity is always high, varying between 72 per cent for January and 91 per cent for June and July. The range of the temperature is not great. The average temperature for January, the warmest month, is 49° F. and that for July 37° F., although summer temperatures may rise to 73° F. and those of winter drop to 22° F. The islands are washed by a cold current[3] and the mean annual temperature is comparatively low, 43° F., slightly below that for the Faeroes, in a latitude 10° higher.

In this prevailingly raw, cloudy, windy, and moist climate only hardy sheep of the greasy crossbreed variety will thrive, a breed in which the Romney Marsh characteristics predominate. The islands support 668,000 head of these sheep, which produced nearly 5,000,000 pounds of wool in 1920. Owing to climatic conditions, this wool has remarkable and distinctive properties; the fiber has a fine texture and a light specific gravity, which makes it especially valuable for hosiery and finger-yarn articles.[4]

Each of the large sheep ranches has its headquarters consisting of the manager's house, cookhouse, wool sheds, and sheep pens at a settlement situated on a good harbor of the highly articulated coast. The little huts of the shepherds are scattered about the large farms. In many cases a whole small island constitutes the farm, and its only human inhabitants are the man who owns or manages the island, his wife and children, and his few employees. There are no roads on the islands. In many areas the jagged rock ridges are difficult to traverse; in others, extensive stretches of moss growth form treacherous bogs, in which many a horse and rider have lost their lives. These difficulties render traveling hazardous and force it to be made entirely on horseback or on foot. Overland communications are reduced to the minimum. On the other hand, freight, mail,

[2] C. E. P. Brooks: The Climate and Weather of the Falkland Islands and South Georgia, *Geophys. Memoirs No. 15*, Meteorol. Office, London, 1920, pp. 95–146. Discussed by C. F. Brooks in the *Geogr. Rev.*, Vol. 11, 1921, pp. 626–628.

[3] R. C. Mossman: Las condiciones físicas del Atlántico sur entre el Río de la Plata y las Islas Orcadas del Sur durante el verano, *Oficina Meteorol. Nacl.*, Buenos Aires, 1922.

[4] The Empire's Trade in Wool in Its Relation to the Wool Trade of the World, *Bull. Imperial Inst.*, Vol. 16, 1918, pp. 476–515; reference on p. 483.

and passengers are carried by water between the different parts of an island and between the numerous islands by the Falkland Island Transport Company. The fiord coast, with indentations extending far inland, brings all parts of the large islands near water routes (Fig. 1). Yet the maintenance of interinsular communication is attended with difficulty because of high winds, rough seas, and rock-bound coasts. The steamship *Falkland* leaves Port Stanley monthly, within 72 hours of the arrival of the mail vessel from England, to call at various points on the islands.

FIG. 2—A sheep station on West Point Island (latitude 51° 20′ S., longitude 60° 40′ W.). Stations are located on or near the coast because all transportation is by water. (Photograph by Rollo H. Beck, of the American Museum of Natural History.)

The boat distributes the mails and the imported food products, clothing, and building materials to the settlements and picks up the wool, hides, and skins, which go to Port Stanley for export.

THE EXPORT TRADE AND THE WHALING INDUSTRY

In spite of the dominant importance of sheep raising on the Falklands, wool comprises only eight per cent of the total value of the exports (1920). The paradox is explained by the economic sphere of influence of Port Stanley. Wool is a local product; the bulk of the export from Port Stanley is constituted by whale produce (chiefly oil) derived from the seas of the Dependencies, around South Georgia and the South Orkney Islands more

than 1000 miles away. The exports of whale oil in 1920, a typical year, amounted to ten times those of wool in value and 16.8 times in weight.

The whaling industry of this area in its present dimensions dates only from the beginning of the present century. In the old days of deep-sea whaling the species hunted were limited to the sperm whale—which was the source of spermaceti oil—the bowhead, and the right whale. Before the invention of the steam whaler and the harpoon gun in the sixties of the last century, difficulties in the way of capture and reduction rendered impracticable the hunting of other species, although several were capable of yielding whale oil. The introduction of shore whaling made it possible to take these "finner" species, among which are the humpback and finner whales, so abundant in the region of the Dependencies. The new method has been developed largely by Norwegians, who in pursuit of their ancestral tasks have settled in Port Stanley or live in the temporary whaling colonies in South Georgia.[5] The industry employs about 600 persons of the Falkland port and 1000 men on the Antarctic littoral during the whaling season. There are 21 companies operating in the region of South Georgia; fourteen of these work from Port Stanley as a base, and the others, from northwestern Europe, operate primarily through Port Stanley. The industry is carried on by large companies chiefly because of the remoteness of the fishing grounds, the recent development, and the type of whales taken.

Port Stanley, while 1000 miles from the whaling grounds, lies far to the south of any other adequate port that could serve as an outfitting point for the fishing fleets. The harbor affords protection in all sorts of weather. It has regular communication with the United Kingdom, where most of the whale oil is sold. Being a coaling and supply station it can provision the ships engaged in whale hunting.

South Georgia and the South Orkneys have a more rigorous climate than the Falkland Islands; they are smaller and more rugged, unfavorable to permanent settlement. Attempts have been made to raise sheep, especially in South Georgia, but without success. The western slope of this island is permanently snow-covered down to 2000 feet above sea level, and glaciers fill all the valleys. However, the eastern slope, swept occasionally by warm dry *föhn* winds from the mountains, is almost free from snow. The South Orkneys, South Shetlands, and Graham Land are generally ice-covered and enclosed by packs and are practically useless even as shelter for whalers.

Whaling operations are carried on primarily during the summer months (October to March) because whales are more plentiful and climatic conditions more favorable at this season than at any other time, though even

[5] T. E. Salvesen: The Whale Fisheries of the Falkland Islands and Dependencies, in "Rept. on the Sci. Results of the Voyage of S. Y. *Scotia* during the Years 1902, 1903 and 1904 (Scottish Natl. Antarctic Expedition)," Vol. 4, Zoölogy, pp. 479–486, Edinburgh, 1915.

Rept. of the Interdepartmental Committee on Research and Development in the Dependencies of the Falkland Islands, Presented to Parliament, April, 1920, Cmd. 657, London, 1920.

in summer whalers must endure disagreeable weather and rough seas. Moreover, the season in the more southern district around the South Shetlands and the South Orkneys lasts but two or three months, according to the proximity of the ice pack.

When a whale is caught, the oil is taken and the bones and meat are converted into fertilizer either on a floating factory in a harbor or in a land factory on South Georgia, which has several of these large establishments.[6] The floating factories, mostly old passenger steamers converted for the purpose, are fitted with boiler digesters and can be operated at far less expense than a land station. They are sent out to the whaling grounds both from Europe and Port Stanley.

The Import Trade

The imports amount to only one-fourth of the total trade of the Falkland Islands. Four classes of commodities make up four-fifths of the imports: coal and coke, 50 per cent; groceries, 20 per cent; hardware and machinery, 7 per cent; and structural timber, 5 per cent. The important place of coal and coke is due to the large demands and the lack of available fuel. There is neither coal nor wood in the islands, and the constant humidity of the air prevents the drying of peat. Fuel is needed in all the houses throughout the year because of the prevailingly cool, moist climate. It is consumed in the three canning plants that dispose of the surplus sheep, by the many vessels that coal at Port Stanley, by the land whale factories on South Georgia and the floating whaling factories, some of which are equipped at Port Stanley, and in the ship repairing industry of this port.

Most of the foodstuffs required by the islanders must be imported. Only about 150 acres are under cultivation, for the most part experimental oat fields. The results, while somewhat encouraging, indicate only limited development along this line. Wheat will not ripen at all, and barley and oats rarely mature properly. Vegetables can be produced only with difficulty. Therefore every article of food except mutton and penguin eggs is scarce (Fig. 3). Milk and other dairy products are hard to procure, and fresh vegetables—even cabbage and potatoes—are largely a luxury. Sheep cannot be grazed successfully on the same pastures with cows, and fencing materials are costly. Consequently many farmers make no attempt to keep cows. Moreover, because of the remoteness of the islands, only certain commodities—breadstuffs, canned goods, and dried fruits—which can be transported long distances without noticeable depreciation, enter into the trade.

[6] J. Q. Dickson: The Empire's Outpost in the South Atlantic. *United Empire*, Vol. 7 (N. S.), 1916, pp. 161–172, London. Noted in *Geogr. Rev.*, Vol. 6, 1918, pp. 286–288. See the illustration of Leith Harbour, Figure 1, and the whaling station at King Edward Cove, South Georgia, Figure 2. For some new and excellent illustrations of harbors and whaling stations of South Georgia see Commander Wild's book "Shackleton's Last Voyage," noted in this number of the *Geographical Review*.

Hardware and machinery are important in the trade because the Falkland Islands do not possess raw materials, power, capital, or skilled labor. Nearly all of the newcomers to the islands are shepherds from the British Isles. They earn $44 a month, with food and housing supplied; and when reverses come in the sheep industry, rather than enter some trade for which there is scope, they proceed to Tierra del Fuego or to Patagonia to take up similar work.

The case of lumber and timber products is similar to that of coal and coke. No lumber is produced in the islands, and a constant demand for it exists. The headquarters buildings and the shepherds' huts on the sheep stations and many of the houses in Port Stanley are constructed of imported timber products. Structural timbers are required constantly in connection with the ship-repairing industry of the port.

Port Stanley

A fraction of over one-third (900) of the people of the Falkland Islands reside in Port Stanley, the only town in the islands and the headquarters of the colony since 1844. It is on the leeward side of East Falkland and stands on the southern shore of an almost landlocked harbor three miles long and one-half mile wide. Along the waterfront are many old ships moored in the harbor and used as storehouses. On either side of the harbor, rock ridges rise to considerable heights and, with the narrow opening, afford protection from all winds (Fig. 1). This sheltered harbor, lying in the path of the westerlies from Cape Horn, is the refuge of many a sailing vessel and numerous steamers battered and crippled by the stormy seas of that region. There is hardly a month, even at the present time, when one of these disabled ships does not find its way into Port Stanley either to be refitted and repaired for further voyage or to be condemned as unfit for service and remain as one more of the many victims of the sea interned there. Stranded sailors and their descendants form an appreciable proportion of the population. These persons work at ship repairing or engage in fishing on one of the floating whale factories, many of which are patched up and fitted out in the ship-repairing yards.

The Future of the Colony

There seems to be little opportunity for further development of the sheep industry. Several small islands that have not been settled may afford new pasturage. On the other hand, the carrying capacity of the ranges in the older districts seems to be on the decline. As a matter of fact, when the sheep industry in 1867 was established on a permanent footing, tussock grass, excellent for grazing purposes, grew on all the islands. To this grass was due, in part, the great increase in the number of sheep—35,000 in 1867, 283,000 in 1877, 563,000 in 1887. In 1896 a record total of 801,000 was reached. Since then the numbers have been on

FIG. 3

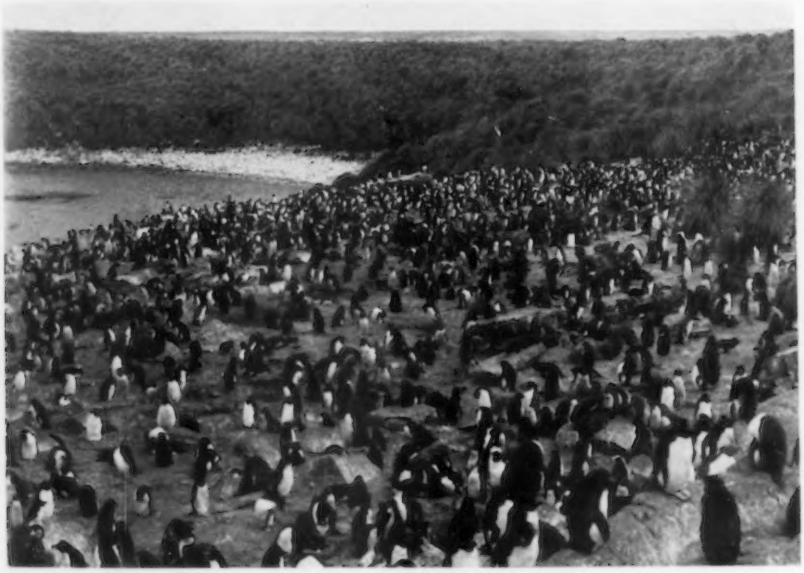


FIG. 4

FIG. 3—Collecting penguin eggs on Kidney Island (north of Cape Pembroke). Penguin eggs form an important source of food in the islands. A government license is necessary for the privilege of collecting the eggs, and some colonies are seldom disturbed. (Photograph by Rollo H. Beck, of the American Museum of Natural History.)

FIG. 4—Kidney Island, the Falkland Islands. A Penguin colony. In the background is tussock grass, which supplies a hay crop from the smaller islands. Overgrazing on the larger islands has destroyed this grass. (Photograph by Rollo H. Beck, of the American Museum of Natural History.)

a fluctuating decline. At present the total head of sheep is about 668,000. The tussock grass, originally a valuable food, has been almost eradicated from all the larger islands by overgrazing. The cool, peaty soil now supports only a poor growth of tawny grass, which has little nutriment for cattle, but on which sheep do fairly well. The ranges are now stocked to capacity. During the last few years two canning factories were established to utilize the surplus sheep. In addition, some overstocked ranches are sending them to Punta Arenas in Chile and to Buenos Aires.

Some development may be expected along other agricultural lines—the growing of vegetables and the production of dairy products. Potatoes, carrots, turnips, cabbages, Scotch kail, and rhubarb may be produced even in the face of unfavorable conditions. The difficulty of raising even these vegetables is the damp, cold, peaty nature of the soil. All the gardening soil is artificial.

Dairy products might be produced in larger quantities. There are about 5500 cattle in the Falkland Islands. Most of these are at the various sheep stations, but some still run wild. The production of a local supply of milk and butter at the various stations involves the fencing of pastures for the cows, for they do not thrive on pastures grazed by sheep, and the storage of a forage crop for winter feed. Difficulties are met in connection with both these projects owing to the lack of fencing material on the islands and the high price of the imported article and to the disappearance from the large islands of tussock grass, the only herbage that furnishes a hay crop. However, the smaller islands where there are no sheep supply a good hay. Moreover, fair crops of oaten hay can be produced in East and West Falkland, and oats have been successfully used as ensilage.

The ship-repairing industry of Port Stanley has shown a tendency towards decline during the last few years. This has been due to the high cost of lumber and repairs at that port, and to the scarcity of labor; many ships avoid the Falkland Islands and make for Montevideo in case of trouble. Many of the younger men, in recent years, have gone to Patagonia and Tierra del Fuego, and large numbers of the elder members of the community have retired to the British Isles.

The fishing industry is susceptible of considerable development. The whaling industry of the Dependencies, it is true, cannot increase markedly and indeed can approximately maintain its present status only with scientific investigation and development. On the other hand, the physical conditions of the sea between the Falkland Islands and the east coast of South America are such as to support large numbers of fish. The depth of the banks admits of fishing operations. The sea temperatures are not unlike those on the northern fisheries; the region witnesses a meeting of cold and warm currents. The fact that the waters off the Falkland Islands and southern South America support quantities of seals and penguins, beside other birds (Fig. 4), presupposes the existence here of at least a fairly large number of fish. Moreover, direct observation has shown the presence

of edible species, while shoals of fish resembling small herring are reported from Port Stanley. Whether these fisheries will be developed from the Falkland Islands as a base or from Chile, Argentina, and Uruguay will depend on the countries engaged in the fishing operations and on the market regions. Recently these latter countries have taken initial steps for such development. Uruguay has established a fishery institute with the object of developing the industry in a scientific manner and has installed large refrigeration plants. If the fisheries are worked by these countries, little profit will accrue to the Falkland Islands from them. The Falkland Islands have an excellent location for operations on the banks but lack a population with a natural aptitude for the industry. The young men, accustomed to life in the sheep stations, rather than change their occupation migrate to Chile or Patagonia. In all probability, therefore, the Falkland Islands will take at best a minor part in the development of these fisheries and will derive little advantage from their exploitation by other countries.

THE GARDENS OF THE FAEROES, ICELAND, AND GREENLAND

By JOHN W. HARSHBERGER
University of Pennsylvania

Greenland and Iceland in the minds of most persons are associated with barren mountains, frozen plains, and inhospitable conditions generally. But we are beginning to realize that the arctic and subarctic regions are not altogether desolate wastes, that their short summers may be pleasant and the wild animal and plant life abundant. Gardens in Greenland and Iceland, are they possible? Svend Bruun and Axel Lange answer the question affirmatively by the last three sections of their attractively illustrated book "Danmarks Havebrug og Gartneri til Aaret 1919."[1] We are introduced to these far northern gardens by way of the Faeroes.

The Faeroes

A delightful article in the *Atlantic Monthly* for May, 1921, tells of a little garden far up in the sixtieth degree of north latitude on one of the Faeroe Islands:

> In front of the cottage is a large bed of perennials with a little golden locust tree on the upper border. The taller plants are lilac and white lupines, a flowering currant, a foxglove or two, cottage lilies, yellow larkspurs, and one of bright blue monkshood, montbretia, monkey flowers, Jacob's ladders, Shasta daisies, feverfew, mauve and white rockets, doronicums, fair-maids-of-France, an oriental poppy, two peonies, and starry astrantiums. The lower plants are sweet Williams, pyrethrums, lilac and white horned violets, forget-me-nots, potentillas, Iceland poppies, a bleeding heart, Scottish bluebells, geums, catchflies, daffodils, Spanish irises, spiraeas, and wood hyacinths.
>
> And then there is the border. First, a wonderful band of primroses. Never, no, not under Devon hedges, have I seen such a wealth of blossoms, hardly a leaf showing among them. Then comes a band of London pride, or *Saxifraga umbrosa*, or mother-of-thousands, as you choose to call it. And the inner band is poet's narcissus. . . . There are gravelly paths that curve and wind down the slope, as paths should do. . . . They pass under the tiniest trees and between the biggest currant bushes that I have ever seen, and lead to a storehouse, or to a sheltered nook among elderberry bushes, where there are benches and a table."[2]

Hans Kristoffer's earlier gardening was one of trial. Denmark and Norway contributed some plants. Southernwood came from the Shetland Islands, and later came contributions from a Scottish border garden. Few survived when sent from English gardens.

[1] Svend Bruun and Axel Lange: Danmarks Havebrug og Gartneri til Aaret 1919. Copenhagen and Christiania, 1920.

The writer has drawn freely from a translation of the three chapters made for him by Mrs. W. C. Plummer of Philadelphia, permission having been obtained previously from Axel Lange and the publishers to use this material.

[2] Elizabeth Taylor: The Garden of Hans Kristoffer, *Atlantic Monthly*, Vol. 127, 1921, pp. 639–648; reference on pp. 640–641.

Scholars are at variance as to the origin of the name Faeroes. But whether it is derived from sheep or not, certain it is that all the islands are teeming with these creatures, and whatever parts have been brought under cultivation have been laid out essentially for pasture. Sheep raising is not consistent with gardening, as might be expected. The gardens must as a matter of course be limited to the country districts and hamlets which lie near the sea, and everything is on a small scale. The gardener is confronted by severe conditions. Cold is not the worst enemy of plant life. The Faeroes have comparatively a mild insular climate, and the sea never freezes over. The wind, which often earns the name of tempest, or better, hurricane, is far more destructive. Shelters are sorely needed, but the low stone walls, which are found almost everywhere and which are primarily intended to guard against wandering sheep, poorly protect the trees, bushes, and hedges. Hedges in general grow so poorly that they need protection themselves. The Faeroe Islands are the most sunless region in the world. Only five days in the year average an entirely cloudless sky, and as many as one hundred and eighty-four days on the average report a completely clouded sky. As a consequence there is very little summer heat. July in the Faeroes is no warmer than is April in Denmark; and, as the summer is of short duration, the shoots of the trees ripen with difficulty, and only the very hardy kinds can survive the winter. In shelter various kinds will thrive, because there is nothing the matter with the soil.

The parts of the trees and bushes that rise above the stone walls or other shelter are fully exposed to the spring frosts and the sharp winds. The trees make little progress in their struggle upwards; their tops are filled with dry, decayed branches; the whole growth is low, twisted, and dwarfish. The Swedish service tree, or Scandinavian mountain ash, is said to be the only kind whose shoots are not killed in the severest winters. One sees this tree everywhere in the Faeroes, while the somewhat less hardy common ash seems to be more scarce; this is also the case with the other trees which are planted: the birch, large-leaved elm, maple, and larch together with evergreens—white spruce and mountain pine. Of the trees with acicular leaves, the mountain pine is considered the hardiest, and this does not freeze. The beech trees are seen in solitary places and can under good conditions reach a height of three meters. A maple tree eight meters high, the circumference of whose trunk is one meter, is considered the highest tree in Thorshavn and the entire archipelago. The willow in the indigenous flora is represented by the golden osier, *Salix phylicifolia*, but these and other planted kinds are found as bushes.

Fruit trees are entirely lacking. Of fruit bushes currants thrive best, and with sufficient shelter the berries ripen regularly every year. Gooseberries are unreliable but give at least green unripe berries and are used as ornamental bushes, whose early leaves enliven the desolate garden in the spring; the older bushes become quite large with rich foliage. Black currants ripen very seldom and raspberries never. The largest berry

harvest is obtained from the wild berry-producing plants—red whortleberries, blueberries, and crowberries. The people of the Faeroes do not care for ornamental bushes that take up too much space. The friends of flowers take more pleasure in the perennial plants that acquire an amazing size and an abundance of flowers which, in the moist, cool air, long preserve their freshness. It is only within the past twenty or thirty years that the people of the Faeroes have learned to value vegetables. When Rostrup[3] visited the islands the Kvan (*Angelica archangelica*) gardens were almost entirely neglected. The angelica gardens are in many places replaced by cabbage gardens. Of the different kinds of cabbages the cauliflower is the one which prospers best. Stalks of kale break easily in winter in the furious storms. Some of the root crops do well. The cultivation of potatoes has spread fast, but the potatoes must be treated as premature kinds and must be sprouted before planting out in the fields or gardens.

In the "Description of the Faeroe Islands and the Inhabitants of the Islands" written in 1673 by the Dane Lucas Debes,[4] who for many years was minister and teacher in Thorshavn, there are found but few lines on the condition of horticulture in his time. "Here grow both food plants, namely turnips, carrots, cabbages, lettuce, cress, savory, and other such things and many different kinds of wild plants." There were also named some plants of the wild flora, such as sorrel, pepperwort, and scurvy grass, adapted to counteract the common sickness, scurvy. Nearly 120 years later there was published a new description of the Faeroes. This also was written by a Danish minister, Jørgen Landt, who for a time had been stationed in Thorshavn. His "Attempts at a Description of the Faeroes"[5] is still an important primary source. In it he says: "The garden is a neglected institution in the Faeroes. It is really only the people of Thorshavn who, encouraged by the example of the sheriff and the governor, have some appreciation for gardening. In the country only the ministers, as a rule, have gardens." From the plant school at Frederiksberg were sent fruit trees, which blossomed nicely the first summer; but the joy they occasioned was shortlived. The fruit fell off some of them unripe, and the following winter every one of the trees died. "Of all that had been planted outside of the garden, I did not see a trace."

After the years 1899–1900 more progress was made in tree planting. In 1902 John Paturson in Kirkebø, who was then a representative from the Faeroes to the Storting, turned to the Danish Society for Cultivation of Heaths with a request to have a man sent to the Faeroes who should examine conditions there for the growth of trees. After uphill work the nursery was established, and in 1910 the first sowing was undertaken. Many good mountain ashes, maples, and firs have been sent to different places in the Faeroes but not with much success. What the summer builds up,

[3] E. Rostrup: Færøernes flora, *Botanisk Tidsskrift*, Vol. 4, 1870–71, pp. 5–109.
[4] Lucas Debes: Færøa veserata eller Færøernes oc Færøeske Indbyggeres Beskrifvelse, Copenhagen, 1673.
[5] Jørgen Landt: Forsøg til en Beskrivelse over Færøerne, Copenhagen, 1800.

the following winter destroys. Tree planting has been supported by subscription from the parliament of the Faeroes and the Danish administration. That hedges should ever become of great significance is improbable; the stone walls and other shelters are better as they are not affected by wind and weather in the same degree as trees and bushes.

The wild flowers of the Faeroes have been particularly well investigated. Landt[6] has a list of the flowering plants of the Faeroes, 203 kinds in all; then later Rostrup's description appeared;[7] and still later we have had the greatly needed "Botany of the Faeroes,"[8] 1901–1908, published in English. Most of the plants in the Faeroes are also found in Denmark. Of the most northern kinds several have their southern limit in the islands. They are found on the highest mountain tops. Not even the angelica in its northern form is supposed to grow any farther south than the Faeroes. Its history cannot be considered to be fully cleared up as yet, but it is possible that it was found growing wild in the islands before they were settled. Debes puts it down as common. "Here is found a great quantity of angelica, called Kvan, not only in the gardens or churchyards, where it is planted, but also in many places in the wild woods and on the high mountains."

Iceland

Reference to a map of the North Atlantic Ocean will show that the northern part of Iceland just touches the arctic circle and is placed athwart the twentieth meridian of west longitude. It has been isolated from tourist travel; but within the last year or two the summer trips by steamer from New York to North Cape have been arranged so that American travelers can visit Iceland and see its geysers and other scenic features on the outward passage to the land of the midnight sun.

Iceland has long been settled: the date can be given definitely as between the years 874 and 930. Settlements were made on the much diversified coast and in the deep fiords, especially of the south and west coast, whose climate is influenced by the Gulf Stream. The ruins of farmhouses and the continuity of northern agriculture down to the present indicate that the Norse methods of farming, and no doubt the home horticulture likewise, were transferred to Iceland. The old sagas mention the plot of ground, Kvanhaven, in which angelica was cultivated. Consumers of angelica were eager to try the cultivation of their plant in Iceland, for once established it perpetuated itself and could be had readily when needed. There is now no occasion for its special cultivation, for it is found in abundance all over the island. In the gardens cabbages and other more useful plants have taken its place.

The surface area of Iceland, a little under 40,000 square miles, is about three times that of Denmark, but the proportion cultivated is small.

[6] *Ibid.*

[7] *Op. cit.*

[8] Eugen Warming, edit.: Botany of the Faeroes, Based upon Danish Investigations. Copenhagen and Christiania, 1901–08.

The whole of the interior is occupied by barren mountains, snow fields, lava deserts, and heaths. Along the coast is found the arable land, and the population is distributed accordingly.

Formerly gardens were almost entirely lacking or were limited in their cultivation to angelica, but appreciation of horticulture has grown, the use of garden produce has now greatly increased, and various effective forces are at work to deepen the interest in flowers and vegetables to a still greater extent. Reykjavik has naturally been the principal seat for work in gardening, though the capital, occupying an open position, lacks the natural shelter which is the foundation for horticulture in Iceland. Akureyri, the leading city in the north, is far more favorably situated from the horticultural point of view. In the very heart of the fiord, sheltered by the mountains, it enjoys as good conditions as are offered anywhere on the island. However, during the long severe winters the ice packs itself along the northern coast, and its effect is felt over the greater part of the island. Then, if the short summer is late, plant life suffers accordingly, and even the potato crop for which Akureyri is noted, is a failure for the year.

From primitive beginnings the art of gardening had a slow but steady advance, as the perception dawned that there were many plants that could be grown successfully in Iceland. Much of the improvement was due to the interest taken in the enterprise by the Danish government and by the Royal Danish Agricultural Society established in 1769. A little before this time an account of the agricultural state of the country was given by Bjørn Haldorsson, pastor of a northwestern parish.[9] Haldorsson struggled tirelessly for the advancement of gardening and sought during the many years he spent in his Icelandic parish to convince every one he could of the absurdity of the widespread idea that Iceland could not produce vegetables and root crops. And he saw his work rewarded. "Many farmers in his parish and some people of distinction farther away, have from his instruction laid out gardens and have come to use potherbs." Haldorsson was Iceland's pioneer in the cultivation of potatoes, and in this he was seconded by the Agricultural Society.

In the late summer of 1758 Bjørn Haldorsson received a half bushel of potatoes, which were planted in the spring of the following year; and four weeks later he had the pleasure of seeing a crop grow up from them. The potatoes grew well, but it was difficult to get people to eat them. When Bjørn Haldorsson for the first time placed his potatoes, prepared like a porridge, on the table in his home, his family refused to taste such food. Hard was it to encourage the raising of vegetables, which were strange to the meat-eating people of Iceland. "It seemed strange to the simple common people that they should eat grass contrary to the custom of their fathers," complains Bjørn Haldorsson.

[9] Magnus Olafssen: Korte Beretninger om nogle Forsøg til Landvæsenets og i sær Havedyrkningens Fremgang i Island, Copenhagen, 1761.

In 1770 an "Icelandic Garden Book,"[10] was published and to the number of a thousand copies, probably the whole issue, was distributed free of charge. The publisher explained that the work was intended "for the meditation of my countrymen, the ignorant Icelandic farmers," and pointed out that this garden book was the very first of its kind arrayed in Icelandic garb. Two years later the Agricultural Society again distributed gratis in Iceland five hundred copies of a little work, "On the Culture and Use of Potatoes."[11] Two years later still, in the year 1774, another Icelandic garden book was published.[12] This work also, which was prefaced with a long commemorative poem, was distributed to the number of five hundred copies in different parts of Iceland. In appearance and subject matter the first two Icelandic garden books resemble each other greatly. Both treat exclusively of vegetable gardens and, after the custom of the time, give aromatic herbs, of which a small number grew in Iceland, a comparatively prominent place.

Under his latinized name, Olaus Olavius, Olaf Olafsson wrote an essay, "On the Natural Products of Plant and Animal Life in Iceland Most Worthy of Encouragement," which was published by the Agricultural Society.[13] It treats also of vegetables and praises Jerusalem artichokes for their usefulness. The angelica, which is called by its prevailing popular name, Ætihvønn (Spisekvan), receives mention; and there is recalled the old edict in the law books, "Graagaas," according to which any one who takes angelica from another's land shall pay a fine of six shillings.

In a work published late in the eighteenth century "Attempt at an Icelandic Natural History,"[14] we read about early experiments in gardening in Akureyri. The merchant Lynge's improvements are praised not only because of his potherbs but also because he was supplied with flowers—wallflowers, lupine, mignonette, goldthread, and others. Indeed, according to reliable reports "a modern pear was supposed to have been grown in the same garden." The tree with this wonderful, solitary fruit died later, but the fame of the pear had already spread widely.

In the year 1883 George Schierbeck, doctor and horticulturist, gratefully remembered in both capacities, took up his work in Iceland. He laid out his lot of ground of 4000 square ells in Reykjavik for experimental cultivation on an extensive scale, surrounding it on all sides with a six foot wall of planks as a protection against the biting winds to which Reykjavik is exposed. Many hundreds of kinds of seeds and plants were sent to him from Copenhagen and Christiania. Schierbeck published the results of the experiments in Icelandic as well as Danish periodicals and also had the satisfaction of seeing them appreciated in wide circles. Two years after his arrival he established "The Icelandic Horticultural Society."

[10] Islandsk Urtagards Bok, Copenhagen, 1770.
[11] J. K. Trojels: Om Kartoflens Avl og Brug.
[12] Lachanologica islandica: Maturtabok.
[13] *Landhusholdningsselskabets Skrifter*, Vol. 3, 1794.
[14] N. Mohr: Forsøg til en islandsk Naturhistorie, Copenhagen, 1786.

The work of the Society was supported by the Danish government and parliament. One of the problems he encountered was that of procuring good garden seeds and of placing them in the hands of the consumers so that they could be sown as early in the spring as possible. The raising of Icelandic stocks of cultivated plants was another object. The Society established an experimental garden in Reykjavik.

Horticulture is now supported by 180 local agricultural societies, and agriculture as well as gardening has now several experimental stations at its command. There are given yearly courses in horticulture at the experimental station in Reykjavik. The courses are offered in spring and last six weeks, with both practical and theoretical instruction. The attendance is generally about twenty which, considering the circumstances, is gratifying.

Strictly speaking, market gardening hardly exists in Iceland, for except in the case of experimental stations production and sale are on a limited scale. The vegetable garden naturally predominates; fruit is excluded, and on many farms even a flower garden is lacking. But in the vegetable gardens almost as many different kinds of plants are grown as in Denmark. Sowing in the ground is for the most part unsuccessful. The plants grow too slowly and cannot develop to maturity in the short, uncertain summer. The gardener sows in boxes, pots, and the like, with or without bottom heat, and then plants out later. Potato cultivation advanced and improved greatly during the World War. The Icelandic method of wintering potatoes and other roots has been a model for the Danes.

As has been said, fruit trees do not thrive. Schierbeck and others tried various kinds, but the trees almost always died the following winter. In addition to the old pear tree in Akureyri, there was an apple tree in a garden in Reykjavik; but it remained barren.[15] Of berry fruits only currants ripen regularly, at least in most places. Wild berries grow in many places and are planted now and then in gardens, but the large improved strawberries give ripe berries only in Friland, where they are cultivated in beds surrounded by a frame and covered with glass. In the summer of 1916 a half score pounds of strawberries were raised in the experimental station in Reykjavik.

The Icelandic forest is almost exclusively a birch copse formed of the common birch. Often the trees are mere bushes, but in some places they rise with straight trunks to a height of ten meters. One of the prettiest copses, found at Baejarstadur, has been described many times.[16] Intermingled with this, as in many other Icelandic copses, is the common mountain ash which grows nowhere in pure forest. It reaches the same height and in a favorable situation is able to produce fully ripened fruits. Akureyri was long famous for a large and beautiful mountain ash which, however,

[15] E. Erslev: Om Havedyrkning i nordlige Egne, *Geografisk Tidskrift*, Vol. 1, 1877, pp. 87–95.

[16] Thorvaldur Thoroddsen: Fra det sydøstlige Island, *Geografisk Tidskrift*, Vol. 13, 1895, pp. 3–37. Helgi Jónsson: Vegetationen i Syd-Island, *Botanisk Tidsskrift*, Vol. 27, 1906, pp. 1–82.

was unfortunately lost through a fire in 1902. Several species of willow are found in the birch forests and also as independent copses, and both the native and several imported kinds are frequently planted. The golden osier (*Salix phylicifolia*), which is not found in Denmark, is common and reaches a height of three meters. Beam trees and Swedish service trees do not grow wild but are found here and there in the gardens.

The number of planted trees is small, but various kinds are to be seen in front of the dwellings of garden lovers. The large-leaved elm thrives but grows slowly, the highest example in Reykjavik and in Iceland, a tree of about five meters, stands near the house where taught Iceland's well-known geographer, Thorvaldur Thoroddsen. A Norway maple (*Acer platanoides*) of the same height is also found in Reykjavik, and also a six-meter-high bird cherry (*Prunus padus*). Of deciduous trees with acicular leaves the Siberian larch thrives well. The evergreen tree best adapted to the climate is the mountain pine. It has been planted on Thingvellir Mountain where it reaches a height of about one meter. White spruce and red pine have both been tried but have not spread greatly, the latter at least craving more shelter than is found in Iceland. The ornamental bushes of the garden are all rather modest, and there is found no show of flowers equal to that which adorns the Danish gardens in earlier summer.

The true perennials, just as in Denmark, are the most numerous and conspicuous flowers in the garden. Wild flowering plants have been transplanted in gardens, and in early days those kinds were cultivated that were valuable as medicine or as food. Yet before the monastic gardens reached the north the angelica was cultivated, and other plants like spoonwort, thyme, and rosewort were planted near the houses.

Greenland

The coasts of Greenland are deeply indented with fiords, many of which are filled with glaciers that descend to the sea and produce vast numbers of icebergs. The east coast with its intense glaciation and accumulation of ice drifted by the currents of the north polar basin is a forbidden land. The west coast, although mountainous and glaciated, is more favorable for settlement. The whole interior of Greenland is covered with inland ice which buries the valleys and mountains, leaving only mountain tops, or *nunataks*, visible above its surface. The towns, occupied by the ruling Danish class and the Eskimos, are confined to the immediate coast line. Plant life is also restricted. This is due not only to the cold, which is a limiting factor, but also to the darkness of the winter, which is not counterbalanced by the perpetual day of the short summer. Compared with the area devoted to gardens in the Faeroes and Iceland that of Greenland is of no consequence. Almost without exception the small gardens are confined to the large colonies and are kept up by the resident Danes. In the smaller settlements, as a rule, no gardens are found. The native Greenlanders, the Eskimos, are hunters and fishers. With few exceptions, it is

impossible to arouse in them any appreciation for horticulture; but they do not reject vegetables if offered to them as food. They are very fond of their native angelica, which is found growing wild as far as Disko Island, where it finds its northern limit (about 70° N.). The botanist, M. P. Porsild, who has given an account of the vegetation of Disko Island[17] informs us that the angelica valley behind Ujaragsugsuk from time immemorial has been known far and wide by the Greenlanders, who have been accustomed to make pilgrimages to it from great distances. The angelica grows here 555 meters above the sea in a copse of willows along a brook. Porsild's guide filled his sack with the young, juicy stalks which were peeled and then eaten raw. "One must wonder at the fact," writes Porsild, "that such an apparent, obvious idea as that of sowing seed or moving living plants to more accessible places is still far from the minds of this hunting and nomadic people, that even today this has not occurred to any of them in spite of the close contact with Europeans and in spite of their personal knowledge of European gardening."

In the far north, on the bare rocky plains of Upernivik (latitude 73° N.), gardening is almost impossible. In Friland little more can be grown than radishes, which as faithful, persevering companions follow man farthest in his journey poleward. In a hotbed a gardener who is interested and patient can raise onions, chervil, parsley, lettuce, and other vegetables. Umanak has better conditions. It is a little farther south and lies farther up the fiord, but, as the ice pushes into the inner end of the fiord and lasts long, the gardens are always exposed to danger. Circumstances are similar in the somewhat more southern colony of Jakobshavn, on Disko Bay, and here and at Julianehaab in southern Greenland Pastor Paul Videbaek for many years experimented with gardens. He has described his experience in "The Danish Atlantic Islands,"[18] and this account contains much of general interest. Potatoes can be cultivated at Jakobshavn, but the yield is small and great care is demanded. More fortunate are the conditions in Julianehaab (latitude 61° N.); but the Danish colonists have encountered great difficulties in the way of regular gardening, for the settlement is near the open sea, where plant life meets more difficult conditions than at the upper end of the fiord. When Pastor Videbaek came to Greenland in 1889 very little interest in gardening was exhibited by the colonists. In the span of a half score years, when it had been shown what the garden in Jakobshavn could produce, a greater interest had been awakened.

In the Greenlandic gardens the hotbeds usually take up most of the space. The raised beds are surrounded by steam pipes, and one can produce as much here as in the Danish gardener's hotbed. Kale grows excellently but, like the radishes and turnips, becomes somewhat flat and

[17] M. P. Porsild: Bidrag til en Skildring af Vegetationen paa Øen Disko tilligemed spredte topografiske og zoologiske Iagttagelser, *Meddelelser om Grønland*, Vol. 25, 1902, pp. 91–239; reference on p. 161.

[18] Paul Videbaek: De Danske Atlanterhavsøer.

tasteless. In the autumn the cabbage stalks are made into bundles and are hung in a dry frost-free place and used during the winter. Cauliflower and early dwarf sugar-loaf cabbage grow very well, only the heads do not become as large as they do in Denmark. Rhubarb and small greens like parsley, chervil, and lettuce are grown without difficulty. Pastor Videbaek's garden, which was really a model of its kind, furnished his home with vegetables the year round.

Godthaab, in middle Greenland, is especially known as the field of activity of Hans Egede, Greenland's most famous missionary. In "Old Greenland's Natural History"[19] Egede has given a description of plant life and a few lines about gardening. The pretty grass meadow with the gaudy flowers called for Hans Egede's admiration, but he openly admits that he does not know much about plants. Of course, he knew the angelica. "The angelica plant grows in abundance," he writes, "barley has been tried but does not ripen. Turnips and cabbages grow very well, especially the turnips, which become quite large and of extraordinary good and sweet taste." Potatoes are not mentioned and were evidently unknown in Greenland in Egede's time.

Henrik Rink, scientist and government official (he was the first colonial manager, later inspector of South Greenland), was deeply interested in the economic development of Greenland and did much to encourage the cultivation of vegetables in the southern part of this country. His principal work, "Greenland,"[20] gives an account of the condition of gardening.

The soil of Greenland can be extraordinarily fruitful. It has never been under cultivation and is not impoverished. Pastor Videbaek's garden in Jakobshavn never received manuring but produced year after year an unimpaired, or rather an increased crop. There is always rich manure available in the offal of fish. But there are places where mold is lacking, and a great deal of garden earth has been brought from Denmark and Scotland to the Danish colonies.

In the series of narratives, "From the Greenland That Was,"[21] Mrs. Signe Rink has given a lasting picture of Greenland's colonial gardens during a half century. A low red-painted paling encloses the garden plot, where cabbages, parsley, turnips, radishes—especially the last, "the most excellent vegetable cultivated in Greenland's gardens"—fill the small beds. In earlier times, when life among the Danes in Greenland was simpler than today, turnips were esteemed by every household. Not only the roots but the salted leaves were used as well, mixed with kale. But times have become more refined even in Greenland. The Danes in Greenland, like their kinsfolk in Denmark, now prefer potatoes to turnips. But the cultivation of potatoes presents great difficulties and produces especially in the north a meager harvest. In the extreme south one can expect

[19] Hans Egede: Det gamle Grønlands Perlustration eller Naturale Historie, Copenhagen, 1741.

[20] Henrik Rink: Grønland geographisk og statistisk beskrevet, 2 vols., Copenhagen, 1857. English transl.: Danish Greenland: Its People and Its Products, edited by Robert Brown, London, 1877.

[21] Signe Rink: Fra det Grønland som gik, 1902.

about an eightfold harvest, at Julianehaab only about a sixfold, at Jakobshavn generally only a threefold. All the Danes in Greenland like potatoes, and even the Eskimos value them and in a small way have begun to cultivate them. Cultivation generally proceeds along the following lines. The tubers are planted in pots in March, in May they are planted out in the forcing frames, later the sashes are removed, and in the beginning of September the potatoes can be dug.

One understands what joy it must be for the Danish colonists to succeed in vegetable cultivation in a climate where one would expect them to have to be satisfied with canned goods. They are grateful for dried potatoes, but how much better it is when they can procure fresh ones out of their own gardens! Not much attention is paid to flower gardens. A few asters, nemophilas, mignonettes, and other small summer flowers are about all that are cultivated. Sunflowers have been cultivated in pots at least in Jakobshavn, and the huge blooms cause great amazement among the Greenlanders.

If one wishes to pick a bouquet of field flowers, or rather mountain flowers, it is seldom necessary to go far. The plant life of Greenland can be surprisingly luxuriant. The naturalist Andreas Kornerup has given a lively description of a Greenland forest, or rather copse. Birch and willow bushes formed an almost impenetrable copse at Tumegliarlikfjorden in South Greenland, the mountain slopes were dotted with pastures, the meadows were bright with flowers, and one waded in grass two feet deep.[22] The growth of trees, however, is extremely restricted. It consists of birch copses, such as are described by Kornerup, with a few other kinds: for example willow, green alder (*Alnus ovata*), and American mountain ash. These varieties show that Greenland's plant life is more closely related with that of America than with that of Europe—a now commonly admitted fact, which Professor Eugen Warming, the first thorough investigator of Greenland's plant life, has maintained with great emphasis. The common mountain ash and several species of willow and dwarfish growths belonging to Greenland's flora have found numerous cultivators.

Even where the angelica fails and man has no longer a fixed residence, there are in the northernmost provinces of the polar land fields of flowers. The little trefoil (yellow poppy), *Saxifraga oppositifolia*, and *Silene acaulis* flourish together in the Ice Queen's garden. It is about these three polar plants that Eugen Warming thus expresses himself: "They display an unimpaired vital power up to the most northerly boundaries of life and with certainty could be expected to be found near the North Pole itself, provided that on the whole there were given here conditions for plant life."[23]

If Greenland's Danish colonists take pleasure in their radishes, cabbages, and potatoes, then they also find it in their house plants. From the day

[22] Andreas Kornerup: Om Grønlands Naturforhold, *Meddelelser om Grønland*, 1886.
[23] Eugen Warming: Om Grønlands Vegetation, *Meddelelser om Grønland*, Vol. 12, 1888.

they are sown in boxes or pots until June, when the frames are filled with three to four rows, they are a source of delight. All the summer flowers of Denmark cheer the horticulturist in Friland. Pinks and chrysanthemums, wallflowers and stocks from June until the long polar night fill the rooms with fragrance and color. After the New Year the calla unfolds its white spathe, and the beautiful amaryllis (jacobæan lily) is like a message from the distant tropics. And roses are not lacking, for there are yellow tea roses and pale-red damask roses. Foliage plants—geraniums, aspidistras, begonias, and even palms—are numbered among the potted plants. This is as multifarious and international a company as can be found anywhere. Most of the Danish homes have only a small part of this magnificence, but careful attention has conjured forth something of it in window plants in the coldest inhabited land known to the world.

WORLD WEATHER: A REVIEW*

By Sir Napier Shaw

The author of this work was for many years in charge of Blue Hill Observatory, which was founded, maintained, and directed up to the time of his death by the late Abbott Lawrence Rotch. It is gratifying to find that the activities of an observatory, privately owned and managed, have developed into a survey of world meteorology, because it is to institutions like that of Blue Hill and its associate, the observatory at Trappes near Paris, which was founded and maintained by Rotch's friend, Léon Teisserenc de Bort, that we can look for true freedom of spirit—the best hope of a clue to the intricacies of the world's weather. The two friends jointly organized an expedition to the intertropical Atlantic Ocean for the exploration of the atmosphere over that region. Mr. Clayton was on the staff of the expedition; and, as since that time he has been Forecast Official of the Argentine Meteorological Service, his personal knowledge of meteorological work of all kinds is peculiarly comprehensive. In this book, which is equally comprehensive, he has given the reader the full benefit of his manifold experience. At the outset he treats of daily and yearly periods and later on of other suggestions of periodicity; he discusses at length the relations of weather to the fundamental meteorological elements, also cyclones, anticyclones, sky colors and the physics of the air, radiation, and forecasting.

Tools and Methods

Having recently to form an opinion as to the requirements of productive work in general meteorology, I had arrived at the conclusion that the first need is a library of very special character, with an assistant who knows where to find everything and who is constantly co-ordinating the facts that are known; the second requirement is a well-equipped observatory to keep in touch with atmospheric reality; the third is a physical laboratory with its attendant workshop, in order to explore the possibilities of physical processes that are or may be operative in the free air; the fourth and last is somebody to talk and write about the co-ordinated facts and to think out the mutual relationships of those facts with the physical forces and dynamical laws that observation and experiment have disclosed.

Mr. Clayton's readers will appreciate the reason for regarding a library and co-ordination as the first requisites of scientific meteorology. There are fifteen plates in his book and two hundred and sixty-five figures that

*H. Helm Clayton: World Weather: Including a Discussion of the Influence of Variations of Solar Radiation on the Weather and of the Meteorology of the Sun. xx and 393 pp.; maps, diagrs., ills., index. The Macmillan Co., New York, 1923.

represent facts—myriads of facts—about the weather of the world or incidental thereto such as are to be found only in a good meteorological library, a very rare institution. The speciality of the library, by the way, marks an essential difference between the science of meteorology and the allied astronomical sciences. When astronomers observe the sun or the planets or the stars or the nebulae, they are the same sun, the same planets, the same stars, and the same nebulae for all observers. When the "solar constants" as observed at Mt. Wilson and Calama differ, it is not the sun but the atmosphere that must be regarded as the cause of the difference; for each meteorological observer has only his own piece of atmosphere to work upon, different from that of every other observer. All are parts of one atmosphere, it is true; but no two samples are the same. Every single observation is unique in space as well as in time and can never be repeated. It may be discredited and discarded, but it can never be corrected. Hence, co-ordination of meteorological facts is in itself a problem of no little difficulty. And here we come upon an interesting feature in the progress of meteorology, namely, the line of approach to co-ordination of the facts. A method which has become habitual and almost traditional is to approach them armed with the conception of some particular physical process or some special mathematical formula: we may call it the method of the working hypothesis; and so far does instinct impel criticism that it is hardly an exaggeration to say that in some quarters meteorological observations are regarded as unnecessary unless they are guided by or directed towards the verification of some hypothesis and should not even be undertaken, still less multiplied, except on that basis. To make an experiment in a laboratory without the guidance of a working hypothesis is not science but child's play; and, since the atmosphere is only a physical laboratory on the large scale, the same scientific method is the only one that deserves encouragement.

But there are other minds to whom the process of sallying forth with the law of convection or of radiation or of evaporation and condensation, as illustrated in the laboratory or contained in a neat mathematical formula, to solve the problem of the atmosphere does indeed suggest David going out with his sling and his rounded pebbles from the brook to conquer Philistine ignorance by hitting one of its giants on the head; with this difference, that the giants whose carcasses litter the history of meteorology are not always stuffed with facts but sometimes with somebody's fancies.

Viewing the Atmosphere as a Whole

To such minds it seems that real progress depends upon viewing the atmosphere as a whole, as a general circulation with local disturbances, and that the conception of the whole must be in actual accordance with facts and must not be adjusted to the requirements of a formula; that to spend time producing reasoned explanations of arrangements which do not

satisfy that condition is intellectual lotus-eating, tempting beyond the powers of human resistance, doubtless producing beautiful dreams of the triumphs of mind over matter, but "cutting no ice." Take, for example, the familiar problem of land and sea breezes, such an obvious application of the principle of convection to a limited area and so useful for the school-teacher; how much better off for it is the meteorologist? It is to be feared that the answer is "nothing" unless the motion of the breezes is brought into relation with the general circulation of the air in the whole neighborhood of the locality to which the theory is applied. The question "How does that little region manage to become isolated so as to exhibit the phenomena of convection as though it were a closed space?" is far more vital for meteorology than a description of a process in the free atmosphere on the analogy of what happens in a space with walls and windows, which are unknown in nature where the atmosphere seems to be made up entirely of ceilings. It is now easy to understand that air warmed at the surface will rise until it finds its own potential temperature and then spread out as a layer in this direction and in that; but that, having spread over the sea, it should come down again and recommence its function as cold air wants a good deal of examination before it becomes an explanation.

The whole difference between these aspects of the general meteorological problem may be set out in the question "Shall we approach the solution of our problem by thinking of the forces that are operative, deducing the motion which they must produce and comparing it with observation, or shall we first make out what the motion actually is, in its length and breadth and height, and be led thereby to identify the forces that produce it?" It is a philosophical question, which has an interesting history too long for discussion here.

Yet there can be no doubt that the second alternative is coming to be recognized as the meteorologist's real duty. Mr. Clayton shows by his title "World Weather" that it is in his mind. It is an arduous duty and rather a thankless one, as the dedication of his book indicates; the data are hard to get, hard to find when they have been got, to co-ordinate when they have been found; the gaps are many and vexatious. Some day we are going to have an international encyclopedia of meteorological information with actual working data for the whole world, the product of a complete *réseau mondial;* and the science is going to have its own inductive axioms, its own definitions, and its own analysis. The laboratory and the mathematical textbook are going to be our guardians and our guides though not our jailers. Yet in one lifetime how small is the progress that can be achieved!

> . . . Evermore
> Most weary seem'd the sea, weary the oar,
> Weary the wandering fields of barren foam.

Prominent among the people who have endured the labor that is implied in regarding the world's atmosphere as one and indivisible are Humboldt,

Dove, Buchan, Hann, and Hildebrandsson; but the majority of meteorologists are always tempted to become lotus-eaters.

> . . . Our island home
> Is far beyond the wave; we will no longer roam.

Too many content themselves with the local application of isolated physical and mathematical principles, thereby providing marginal notes for a text which is not yet in existence and which will not be until we can form a real working picture of the circulation of the atmosphere true to all the known facts.

Facts and Forces: Atmospheric Circulation

With the indefatigable workers at the oar of the world's weather Mr. Clayton now associates himself; but he is perhaps not quite whole-hearted in his adherence to the principle of making sure about what one has exactly to explain before embarking upon the explanation. One sign of it is that his first chapter is on the *forces controlling the weather* and not on the *facts which define the weather;* and another is a way he has of interjaculating, as an *obiter dictum*, an explanation of the distribution of pressure as the effect of this or that peculiarity of temperature, as though the causes of distribution were simple. No doubt in co-ordinating facts it is well to have physical and mathematical principles always in mind, and they must be got ready beforehand; but they ought not to be taken for granted from the ordinary experience of the laboratory; they ought to be worked out to open-air conditions so that they may illuminate and not blind the judgment as to facts. How anybody can, for example, put forward the diagrams of atmospheric circulation of Maury (1855), Ferrel (1856), and Thomson (1857) (pp. 41–43) as purporting to represent reality without a sort of feeling of being "accessory after the fact" to a crime against science, I cannot understand. All that one can say about those diagrams is that nobody could possibly sleep in peace if he tried to make them fit in with the distribution of pressure which is shown on page 40 opposite to one of the *pièces de conviction* and is without doubt the most certain co-ordination of our knowledge of the meteorology of the globe. Why, we wonder, is the "circulation" upon a hemispherical projection and the pressure which ought to be correlated therewith on Mercator's projection? One or other of those two representations of the atmosphere must go by the board before a scheme of forces for the atmosphere can be said to accord with facts; and there is no doubt which one it ought to be.

It is, of course, not necessary, nor is it possible to begin straight off with a picture of the circulation of the atmosphere complete in all its details, though Halley and Dampier made better shots than Maury or Thomson. The first draft may quite fairly be a rough sketch; but it is possible and in every way desirable to arrange the outlines so that each additional fact or group of facts for the surface or the upper air, as it comes in, can

find its natural place in the scheme. It is also possible to use our knowledge of physics and dynamics to avoid extrapolations which give impossible results; and it is also good to trust to the sound principle that actual facts are never really in conflict with physical and dynamical laws though they may be in conflict with our ignorance of those laws. Seriously, it is time that a picture of the world's atmosphere in complete zones of uniform flow with as much north or south motion as east or west motion should be understood to refer to Jupiter or Mars, which are some millions of miles away from any possible verification, and not be taken as representing the facts upon which for better or worse the science of meteorology of our own globe must be based.

Such facts as are represented in the diagrams of so-called atmospheric circulation are redolent of the surface, the part of the atmosphere best adapted for showing the peculiarities of the circulation rather than its generalities.

These things are neither mere detail nor unimportant: the future depends upon precision of statement and accuracy of representation. In Chapter 4, for example, Mr. Clayton treats of changes of temperature as waves—hot waves or cold waves. In ordinary language a wave means anything which goes up and down and travels at the same time; but in scientific language wave motion is a special kind of motion in which the form travels but the particles merely oscillate over a small range. Which of these ideas Mr. Clayton has in mind he does not say; but observation can certainly provide an answer to the question.

The "Ascending Current"

Or take another example. Meteorologists in common with other folk are accustomed to bring in an "ascending current" as though it were one of Nature's simplest efforts. Yet most of the evidence which we can get is in favor of the "non-ascending layer" rather than the ascending current, so that the correct description of the normal behavior of warmed air would be that it spreads out in a non-ascending layer as soon as it has found its proper plane. If we think of the observation of a pilot balloon, specially designed to make a rapid ascent, its frequent fate is to get beyond the power of the telescope in, say, ten minutes; and if, instead of hydrogen in a light envelope, we have merely air warmed two or three degrees the column would have to be of incredible length before it formed its cumulus. The ascent of air in the ordinary conditions when cumulus cloud is visible may take fifty miles to accomplish a kilometer of height; and a column of air eighty kilometers long and a kilometer up, at one end, is not what an ordinary person would think of as a column of rising air. Yet the same persons who pass over an ascending current leading to a cumulus cloud as a commonplace event ask us to classify clouds by the process of formation and not merely by appearance.

The Vexed Question of the Cyclone

Another example is afforded by the vexed question of cyclones and anticyclones. How shall we regard a cyclone when it appears upon our map? If we keep constantly in mind the atmosphere as a whole we shall always think of the general circulation as containing a number of cyclones which have an existence for days, sometimes for weeks. "The cause of the progressive movement of cyclones and anticyclones is generally believed to be the general drift of the atmosphere surrounding them at the time. This drift can be inferred with a fair degree of accuracy from the distribution of pressure and temperature in the area surrounding the cyclone" (p. 203). Now this is either true or it is not true. If it is true we shall regard the cyclone newly arrived on a map as a visitor, an existing entity on a journey, and treat it accordingly. We shall not feel it necessary to worry ourselves much about its origin, though we may fairly concern ourselves with the changes which it undergoes in our presence. When a gentleman enters our office we generally ask him his business without endeavoring to explain his origin. We know that in ordinary circumstances he will lose mass and potential energy during his visit; but in some favorable circumstances he may depart refreshed, with his mass and potential energy moderately increased, but still preserving his individuality. If, however, we were imbued with the tendency towards the deductive method, assuming the forces and deducing the motion, our irrepressible instinct on receiving a business visitor would be to explain his origin from the elemental forces, and our business would certainly suffer. We ought not to lose sight of the possibility that during his visit he might be "occluded" and die on our hands, a catastrophe that apparently happens to a good number of aerial visitors to the Norwegian coast. In Norway they "sit upon the ground and tell sad stories of the deaths of kings." But we who live farther west are more apt to tell long stories of royal progresses past our points of vantage. Cyclones that want a long life should be warned to steer for Spitsbergen in preference to Bergen; but most of them have lived long enough to traverse the Atlantic, sometimes diminished and sometimes refreshed and invigorated; and surely it is these that correspond with the typical conditions.

Mr. Clayton is disposed to regard steep gradients of temperature as the immediate cause of cyclones. This explanation is doubtless as good as another. Professor Bjerknes finds the cause in a discontinuity of wind, which is also indicated by a steep gradient of temperature. There need be no hesitation in regarding steep gradients and discontinuities at the surface as of great meteorological importance; but in considering the direct relation of cause and effect one ought, as a general principle, not to expect both the effect and the cause to be prominent at one and the same time; a cause which does not sacrifice itself in producing its effect discredits the proverb that "you cannot eat your cake and have it." It has always

struck me as remarkable about the Bjerknes theory of the cyclone, that he finds the discontinuity, which is the cause, most easily demonstrated in the cyclone, which is regarded as its effect. Some years ago at the London Meteorological Office we were rather closely engaged upon the suggestion of warm air passing over cold water as the cause of sea fog, and we were somewhat astonished to find that when the discontinuity between the temperature of air and sea was most marked there was no fog, and when there was fog the discontinuity was at best very small, until it dawned upon us that if the discontinuity were the cause it must indeed sacrifice itself to produce its effect; that, as the fog was produced by cooling the air, the operation of cooling would diminish the discontinuity. Since that time we have always been shy of seeking conspicuous effects and equally conspicuous causes as likely to occur together. No doubt there are physical effects produced with no sacrifices of cause, such as pressure due to the impact of moving molecules which, according to accepted doctrine, never sacrifice themselves at all; yet if we try the experiment of producing pressure with the jet of a fire hose we find it uses up a good deal of water power. So perhaps we ought to have two classes of the relation of effect to cause and ask for more information; and then in the light of greater knowledge put cyclones in the one class or the other.

Moreover, in considering cause and effect we ought not to pay too much attention to the phenomena observed at the surface to the exclusion of those of the upper air. In a recent paper in the *Quarterly Journal of the Royal Meteorological Society* Kobayasi[1] has shown that one of the chief peculiarities of a cyclone at the surface is a natural consequence of the travel of a symmetrical distribution of pressure, and consequent motion, in the upper air. Hence we are face to face with the question "Is the observed distribution at the surface at any time a cause or an effect?" We may approach the question with calmness in the assurance that, whatever the facts proclaim, theory will be able, sooner or later, to explain; so let us first be sure of our facts, not only for the surface but also for the upper air.

The Sun and the World's Weather

In the latter part of his book Mr. Clayton devotes himself to the study of the sun and its influence upon the weather of the world. In fact the book winds up with a chapter on "The Meteorology of the Sun." The extent and detail of attention paid in Chapter 13 to solar radiation and its application as a method of forecasting for some days in advance give one the impression that it is in the further study of the sun and his radiation that the best hope of progress in terrestrial meteorology is to be looked for; and that impression is certainly based upon undoubted facts. The influence of the sun is, of course, altogether indisputable, and the changes in his radiation as a meteorological element are undeniable; but, as set

[1] Tatuo Kobayasi: On the Mechanism of Cyclones and Anticyclones, *Quart. Journ. Royal Meteorol. Soc.*, Vol. 49, 1923, pp. 177–189.

forth by Mr. Clayton, the subject is afflicted with a certain vagueness, which arises perhaps from the reader's ignorance of a great subject but cannot be dispelled without going below the surface of the book.

It will perhaps be useful to explain this feeling. It is with the variations of the "solar constant" that the meteorological changes are correlated, and the solar constant is understood to be the amount of energy that would be received by a square centimeter of perfectly black surface normal to the solar rays and beyond the confines of the atmosphere. The radiation is measured in gram calories per square centimeter per minute, which is convenient because in that unit the solar constant differs little at any time from 2; but parenthetically we may express the wish that radiation might be expressed in kilowatts per square meter or, for the avoidance of decimals, in kilowatts per square dekameter, chiefly because the use of systematic units is of immense advantage in a science which must ultimately be based on the relationships of physical quantities. This the electricians and magneticians have already abundantly proved; and there are reasons of convenience too. By a happy accident a joule, or watt-second, is a very close approximation to the amount of heat which passes into or out of a gram of air when its temperature changes by a degree (centigrade), and thus radiation and the warming of air are brought into easy relation. Moreover, a kilowatt per square meter, or a hundred kilowatts per square dekameter, is a fair representation of the maximum rate of radiation to be expected in the course of a year at a well-exposed station in the lower levels of the atmosphere. In determining the constant the effect of the atmosphere must be eliminated somehow or other, because the amount absorbed is a large part of the radiation. Hence the solar constant is something which the human eye, or its substitute the bolometer, has never seen and can never hope to see but which the human mind with its amazing ingenuity can calculate.

The calculation amounts to determining, from observations of the energy actually received at different levels, what the total loss of energy is in such favorable positions as Bassour (3600 feet), Mt. Wilson (5800 feet), Mt. Harqua Hala (5600 feet), Calama (7500 feet), Montezuma (9500 feet), Mt. Whitney (14,500 feet) and adding the computed loss to the actual receipt to get the solar constant. The constant so determined is found to vary between 1.90 and 2 gram calories per square centimeter per minute; 1.32 and 1.39 kilowatts per square meter. The variations from day to day are of the order of 2 or 3 per cent of the whole, and on variations of that order Mr. Clayton would have us rely for a substantial part, or indeed the whole, of our changes in weather.

There is as yet no absolute proof that weather changes would not occur without changes in solar radiation, but my own researches have led me to believe that without these solar changes there would result a balanced system of atmospheric changes such that the same conditions would return year after year at the same time of day and at the same time of year; while the irregular changes known as weather result chiefly, if not entirely, from the irregular changes in solar radiation (p. 282).

There is no vagueness in this statement; the only question is whether the atmospheric conditions on the earth are inherently stable or fluctuating under constant solarization. They are necessarily associated with the transference of vast quantities of water vapor from the equatorial to the polar regions and its return as water, and the circulation has to negotiate some very irregular obstacles in the way of land. Consequent irregularities in the circulation would not be surprising.

The vagueness referred to arises from the fact that Mr. Clayton gives no examples of the actual numerical process of determining the values of the constant, upon the variations of which he would have us rely for the explanation of our weather. No doubt the values have been computed on the methods followed by the experts of the Astrophysical Observatory of the Smithsonian Institution, C. G. Abbot, F. E. Fowle, L. B. Aldrich, and A. F. Moore in succession to Langley, and one cannot think of them as otherwise than accurate; still with meteorologists, who feel themselves attached to the earth in spite of the predominant influence of the sun, there is the remembrance of a note that only 24 per cent of the solar energy survives its passage through the atmosphere and as much as 48 per cent has been lost when 1800 meters have still to be traversed. It is impossible when one is thinking about the weather not to wonder what the two or three quarters of the solar radiation captured by the atmosphere are doing in their captivity. Perhaps they are not captured and have only undergone a process of reflection; but, when one is going to base conclusions on the more or less of two or three per cent, one cannot help feeling uneasy about the atmospheric value of the forty-eight or seventy-six per cent; and unless the process of calculation is deeply impressed upon the mind there is a disposition to think that the complication of a diagram quoted from Mr. W. H. Dines on page 276 cannot be altogether circumvented by throwing oneself on the comparatively minute variations of the solar constant. Mr. Clayton does indeed point out that though minute as a percentage it is vast in its intrinsic magnitude; but, if two per cent is so portentous in its numerical expression, seventy-two per cent would nevertheless be thirty-six times as much. One feels indeed a longing to deal with the solar radiation from the point of view of the geophysicist rather than that of the heliophysicist and to see chrono-isopleth diagrams of the bolometric effect of sunshine, hours one way and months the other, for the various stations where observations of solar radiation are regularly made. And if that is too much to require, then one would like at least a more precise indication of what is added to an observation to give the solar constant. Doubtless, again, all these things are written in the books of the chronicles of the Smithsonian Observatory, but they do not jump to the eye so easily as to make one feel that the information is superfluous in a book on world weather.

Naturally it may occur to the reader to wonder why any one should occupy so many words with remarks upon what might be, and perhaps some-

time or other will be, instead of using them to supply the gaps which in a pioneer work like "World Weather" are inevitable; the simple answer is that, so far as the reviewer knows, the material for filling the gaps is not yet in existence and will take more years than he can look forward to for its completion; and in the meantime let it be admitted that reviewing other men's books instead of making a book according to one's own notions is also a species of lotus eating or indulgence in a mild narcotic that dulls the pangs of hunger for the things that might be and are not and, for a time at least, evokes the pleasurable sensations of a postprandial afternoon.

EARLY TOPOGRAPHICAL MAPS

GEOGRAPHICAL AND HISTORICAL VALUE AS ILLUSTRATED BY THE MAPS OF THE HARRISON COLLECTION

Mr. Francis Burton Harrison, former governor-general of the Philippines, has recently presented to the American Geographical Society a collection of books and maps relating to military events in Europe in the eighteenth and early nineteenth centuries. The purpose of the present paper is to call attention to the historical and geographical value of the 551 maps and, incidentally, to suggest a few of many profitable uses to which the historian or geographer might put almost any similar group of early topographical maps.[1]

Such maps are of twofold interest: for what they actually reveal of topography and human geography, and as illustrations of stages in the evolution of cartography.

Topographical and Human Features Shown on the Maps

Though the fundamental physical features of Europe have remained fairly constant during the last few centuries, the human geography of that continent has been greatly altered. The Industrial Revolution has wrought a profound transformation in the appearance of the earth's surface. New roads, railways, and canals have been built; towns have become enormously enlarged and new settlements have sprung into being; forests have been cleared, valleys converted into reservoirs, and marshes drained.

The historian, particularly the military historian, investigating some earlier period should never rely on modern maps alone, provided he can obtain contemporary maps of his period. He should have both before him, contemporary maps to show the human features *as they were* at the time, the modern maps for a more accurate and graphic representation of the relief.[2]

For the student of human and regional geography, early topographical maps provide a means of tracing the evolution of the various human elements of a district. Economic, political, and social forces operating through different historical epochs have all inscribed their record upon the earth's surface. The cultural features, therefore, which appear upon a modern map are an elaborate complex of the old and the new. Two roads are

[1] The maps of the Harrison collection are discussed in greater detail in a booklet of similar title to this paper pending publication by the American Geographical Society. In the booklet (which will be supplied to Fellows of the Society gratis upon application) the suggestions made in the present article are developed more fully.

[2] The fact, therefore, that the Harrison collection is housed in the building of the American Geographical Society where students may make use of the Society's extensive files of modern maps adds materially to its practical value for purposes of research.

represented, each shown by the same symbol. One is an eighteenth century highway: its neighbor was built but yesterday to a newly opened mine. How are you to tell the difference? A series of old maps should help us answer this question by giving a short cut to a chronological analysis. By means of early maps we may segregate many of the composite elements of a region according to their approximate dates. If, in addition, we know something of the history of the region, the maps should go far towards enabling us to interpret directly the facts of present-day geography in the light of the historical events and movements which have produced these facts. And no study in human geography is worthy of the name which ignores the historical factor.

As a simple illustration, compare Dortmund as shown on a map in the Harrison collection dating from 1805[3] and as shown upon the Prussian Landesaufnahme map of 1901[4] (Figs. 1 and 2). On the earlier map the town appears as a small, oval, medieval city without suburbs. The later survey shows the nucleus of the old walled town still clearly in evidence, but it has been surrounded by the larger city of modern times. The built-up parts of neighboring villages have grown, and some have become suburbs of the city. Canals, railways, and new roads are everywhere apparent. In the northern part of the map an entirely new village, Königsheide, with rectangular streets, has emerged upon country that the earlier map represents as heath. These are the facts presented by the maps. For the explanation of these facts, we must look to the history of a century of industrial growth in the Ruhr valley: for the explanation of Königsheide, perhaps, to the town-planning movement of the nineteenth century.

Figure 5 shows a series of cartograms of Brussels and its vicinity all drawn to the same scale from early and recent maps in the possession of the American Geographical Society.[5] These display vividly the story of Brussels' material growth from the sixteenth to the twentieth century. Even if we have no knowledge of the detailed history of Brussels, much may be inferred from these cartograms in explanation of its present urban geography. The positions of certain of the narrower streets of the city were obviously determined by the position of the inner circle of fortifications shown in the

[3] Section 15 of Von Le Coq's map of Westphalia. Approximately 1:85,000.

[4] Sheet 335, 1:100,000.

[5] In Figure 5 the cartograms were drawn from the following sources: "Ca. 1550" from Jacques de Deventer's plan of the city (scale approx. 1:8650) as reproduced in "Atlas des villes de la Belgique au xvi[e] siècle. Cent plans du géographe Jacques de Deventer executés sur les ordres de Charles Quint et de Philippe II," livr. 9, Brussels, Institut National de Géographie, no date. "Ca. 1670" from an undated plan (scale approx. 1:6000) by F. de Wit in an atlas of maps and plans with engraved title page bearing the inscriptions "Atlas. Amstelodami ex officina Jac.[i] de la Feuille. Cum Privilegio Ordinum Hollandiae et Westfrisiae. P. Harrewyn inv: et fecit 1685." De Wit produced many maps and plans during the latter part of the seventeenth and early years of the eighteenth centuries. "1777" from "Plan Topographique de la Ville de Bruxelles et des ses Environs. . . . Gravée par L. A. Dupuis Géographe en 1777" (scale approx. 1:5000) forming plate XXI of "Carte Chorographique des Pays-Bas Autrichiennes . . . Par le Comte de Ferraris." "Ca. 1860" and "ca. 1871" from undated plans (scale approx. 1:14,500) in Bradshaw's "Continental Railway Guide" of about the period. The changes shown in the plan "ca. 1871" were made between 1867 and 1871. "1890" from map of "Bruxelles et ses Environs" (1:40,000) of the Institut Cartographique Militaire.

The built-up areas as shown on all the cartograms have been deduced from the maps and plans upon which the cartograms were based and cannot, of course, be regarded as altogether accurate in detail.

FIG. 1

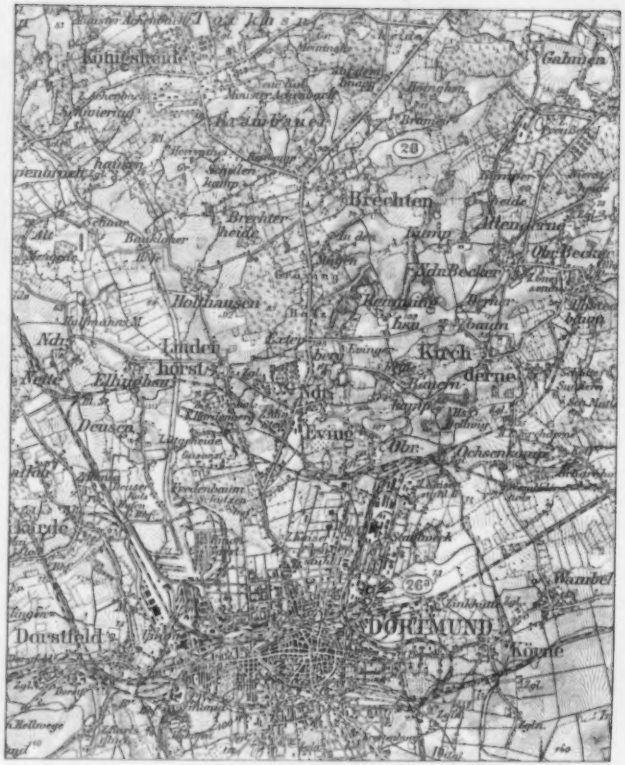


FIG. 2

FIGS. 1 and 2—The vicinity of Dortmund in the Ruhr region as shown upon maps of 1805 and of 1901 reproduced on the same scale.

FIG. 3

FIG. 4

FIGS. 3 and 4—The graphic but inexact representation of relief in the Erz Mountains as shown on a map of 1714–1720 (Fig. 3) contrasts with the careful hachuring of the hills south of Ulm as shown on a map of 1818 (Fig. 4).

cartogram of 1550–1565: the encircling boulevards, as in Paris, replaced the outer ring of fortifications. The Industrial Revolution and the creation of Brussels as capital of an independent Belgium brought an increase in population in the nineteenth century, shown on the maps by a wide expansion of the built-up areas in all directions far beyond the boulevards.

Illustrations of the Evolution of Cartography

The evolution of cartography has been a long and complicated process. Though many studies in its history have been published, the spirit animating most of their authors has been that of the collector or "cartobibliographer." Regarded broadly, the history of cartography as an art and science is still largely a virgin field. The maps of an age depict its intellectual character almost as faithfully as painting and sculpture reflect its imaginative and artistic impulses.

The maps of the Harrison collection serve admirably to illustrate many aspects of the history of European cartography: on the one hand, the close relation between map making and movements in the political, military, and scientific spheres; on the other, technical advances in the field and drafting room.

Two forces were mainly responsible for the improvement of the cartographic art in the period represented by these maps: advance in the realm of pure science, and advance in the art of war. The need of maps of a large scale for peace-time economic purposes seems to have been of secondary importance until the nineteenth century was well under way.

Throughout the seventeenth and early eighteenth centuries the scientific world had been deeply occupied with the problem of determining the size and shape of the earth. The origins of modern topographical methods may be attributed, in part at least, to methods developed in the course of investigations leading toward the solution of this problem. Triangulation as a foundation for map making had been suggested early in the sixteenth century.[6] The earliest triangulations of large tracts were carried through for the purpose of measuring arcs of meridian, and it was an easy step from the use of trigonometric surveys for this purpose to their application to cartographic ends. The first great map of a European country based upon triangulation was Cassini de Thury's "Carte de France," surveyed, engraved, and published between 1747 and 1793. The influence of the Cassini map was very great; indirectly it inspired the inauguration of similar surveys in other parts of Europe; directly it was amplified and corrected by various maps based upon or in extension of it. The results of its influence are well shown in many items of the Harrison collection.

If pure science contributed to the trigonometrical accuracy of maps, war, more than any other force, demanded their production in quantity and necessitated their improvement in the representation of the details of the

[6] See the *Geogr. Rev.*, Vol. 13, 1923, pp. 325–326.

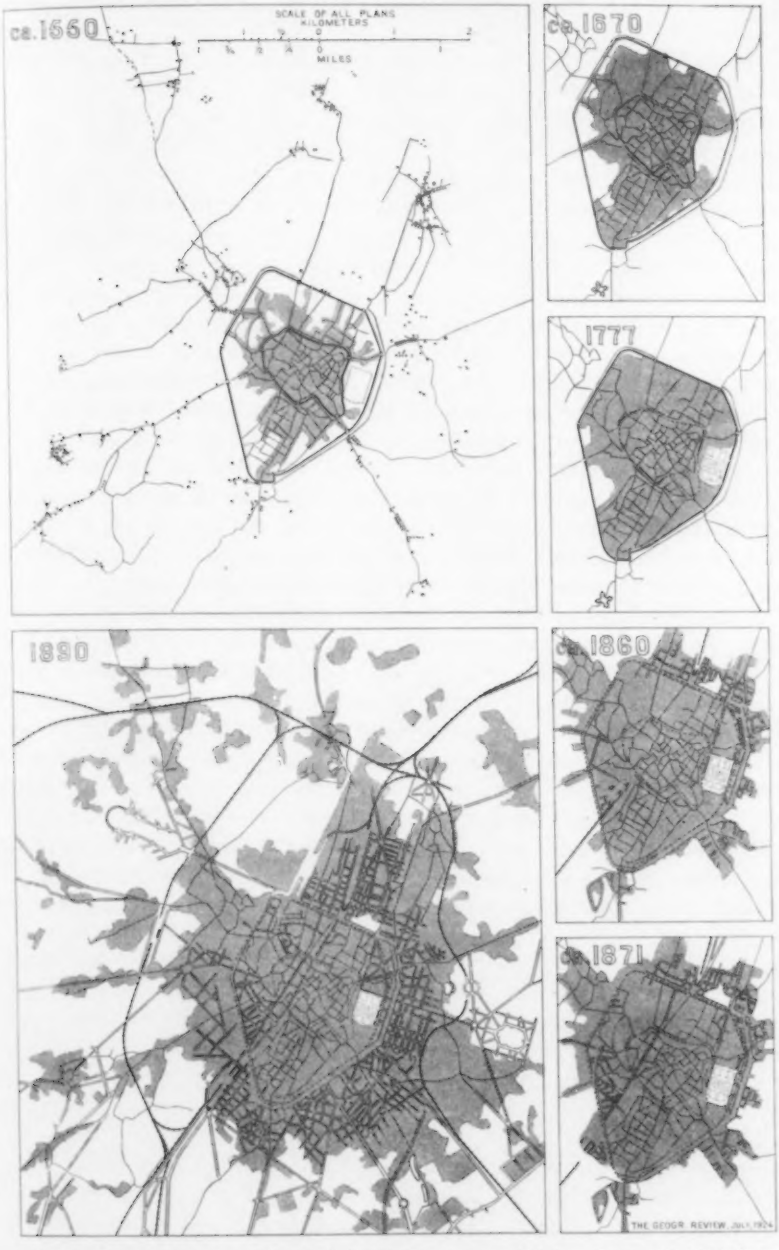


FIG. 5—Brussels 1550–1890. Fine single lines indicate streets which have been continuously in existence since 1550. Double lines represent important streets and boulevards of subsequent date. Heavy single lines are fortifications. Dotted lines are the routes of former fortifications. Fine single lines parallel to dotted lines are boulevards following the line of demolished fortifications. Heavy cross-hatched lines are railroads. Shading indicates built-up areas. Isolated houses in the country are shown only on the cartogram "ca. 1550." For sources see footnote 5.

earth's surface, particularly of relief. With the wars of the French Revolution and Napoleon, the formal tactics of the preceding epoch, when bodies of troops in close order were maneuvered about each other like chessmen, gave way to more individualistic tactics. Greater initiative was expected of the leaders of small units and of the private soldier. In place of refined, geometric conceptions was substituted a closer adaptation of the tactics of each particular engagement to the particular conditions prevailing—conditions determined by the numbers and equipment of the troops, by their morale and leadership, and especially by the terrain. More precise and powerful small arms and artillery added urgency to the need of an accurate understanding of terrain, particularly in the matter of cover, and this expressed itself in a demand for better topographical maps and especially in a demand for maps showing relief with greater realism. Moreover, quite apart from tactical considerations, as armies grew in size at the time of Napoleon and as campaigns were pushed ever farther afield, the requirements of troop movement and transport could only be satisfied by better maps. It is altogether natural, therefore, that the best maps of the first decades of the nineteenth century were produced by the French *Dépôt de la Guerre* and by army officers of the various German states.

Many of the more important of these maps are included in the Harrison collection, and they serve admirably to illustrate the rapid improvements of cartographic technique in a large variety of ways which we cannot pause here to discuss. Suffice it to call attention to Figures 3 and 4, which show side by side a portion of the oldest and most archaic map of the Harrison collection, Müller's "Bohemia" dating from 1714–1720, and a portion of the beautiful *Dépôt de la Guerre* map of Swabia, dating from a century later (1818). A glance at the crude, medieval relief of Müller in contrast with the concisely executed hachuring of the *Dépôt* map, will serve better than many pages of explanation to reveal the extraordinary technical advance that took place during this critical century of cartographic development.

CAPTAIN JOHN SMITH'S MAP OF VIRGINIA, 1612

By Worthington Chauncey Ford

This is frankly a little journey into the realm of hypothesis regarding the actual maker of the map of Virginia that Captain John Smith put forth in 1612.

Earlier Maps of Virginia

Four years earlier Smith's name had been associated with "A trve Relation of such occurrences and accidents of noate as hath hapned in Virginia since the first planting of that Collony, . . . London, Printed for John Tappe, and are to be solde at the Grey-hound in Paules-Church yard, by W. W. 1608." This tract was issued with three variant title pages, and Smith was the author. The tract was written after Smith and Newport had explored the James (Powhatan) and Chickahominy Rivers and after Smith had been carried by his Indian captors across country to the Mattapament (which he made a branch of the James), the Topahanocke, the Payankatank and finally to Waranacomoco, where the Indian chief resided. No suggestion is contained in the tract of a map, either intended or in process of making, though this is not necessarily conclusive on the point, as the seventeenth century editor, "I. H.," admits that "somewhat more was by him [Smith] written, which being as I thought (fit to be private) I would not adventure to make it publicke." In the jealousies then existing among nations on plantations in America the suppression of a map might be defensible—even expedient. The main point, however, is that by 1608 explorations had been made and all the names of Indian towns in the "True Relation" appear on the Smith map of 1612 and very much as his text located them.

No aid from others is admitted in the "True Relation," and it is the same in Smith's tract entitled "A Map of Virginia" (Oxford, 1612). Captain Smith stands sole sponsor for the writings. Between 1608 and 1612 the material for the Smith map was prepared. It is known that Robert Tyndall of the plantation, who had been in the exploring party with Newport, was competent to make a map. An example of his work is "The Draughte of Virginia . . . 1608," which Brown believes was sent to England in 1608 with Newport's journal.[1] An even earlier map of the James prepared by Tyndall and sent to Prince Henry in 1607 is lost, but it could hardly have contained features other than are in his "Draughte" of 1608.[2] Then there is the chart of unknown authorship, of which Zuñiga sent a copy in September, 1608, to his master, Philip III, and which was found in the

[1] Reproduced in Alexander Brown: The Genesis of the United States (2 vols., Boston, 1891), Vol. 1, facing p. 150.

[2] *Ibid.*, Vol. 1, p. 109.

FIG. 1—John Smith's map of Virginia. Dimensions of original 12½ x 16 in.

This reproduction is from the ninth or tenth state of the map (see p. 438).

archives of Simancas.[3] The Zuñiga chart is a copy, Brown asserts, of the map sent from Virginia in 1608 with Smith's "True Relation" and with intention of making it public with that work. The original of the copy sent by Zuñiga was prepared before Smith had fully explored Chesapeake Bay. Fairly correct to the Tappahanock, the Zuñiga copy shows that Smith was hopelessly adrift in the Potomac regions, where he makes a great stream sweeping to the north. What gives this feature peculiar interest lies in the interpretation of it Smith conveyed to Henry Hudson. The Verrazano myth of a great sea, the "Mare Indicum," from which the Atlantic was separated at Virginia by a strip of land of a few miles, had been embodied in maps and still persisted to awaken and color the hopes of those in search of a northwest passage. Smith had sent letters and sketch maps from Virginia to Hudson, informing him of a sea lying to the north of the southern English colony and leading into the western ocean.[4] Acting on this suggestion Hudson sailed for the fortieth degree and found the river which bears his name.[5]

Next in order of time is the map prepared in 1610 for James I, known only by a copy sent in 1611 to Philip III, King of Spain, by the Spanish ambassador in London, Velasco.[6] Although there is a difference of only two years between the Tyndall draft and the Spanish sketch of 1608, on the one hand, and the Velasco map of 1610, on the other, a great advance in knowledge of the bay and rivers is shown on the latter. No one can for a moment believe that Velasco's copyist based his Virginia upon the earlier charts; and the marked, somewhat exaggerated, bend in the Potomac River is that which appeared in the Smith map of 1612 and became a test for determining how far atlas makers incorporated the features of Smith's map. Tyndall had given "King James his River" and "Prince Henneri his River" (the Pamunky); beyond those no rivers were named, nor was the course of any other river so much as suggested in a manner to make

[3] *Ibid.*, Vol. 1, p. 183. The reproduction, *ibid.*, facing p. 184, is unfortunately a tracing from a "copy," and no judgment can be formed as to how far it omitted or imitated the tricks of the original, so useful and necessary in identifying writing and workmanship. The "copy" appears, however, to have been made by an Englishman.

[4] Hudson took the Smith maps and notes to Holland. Samuel Purchas, Hakluytus Posthumus or Purchas His Pilgrims, London, 1625, Vol. 3, p. 590 (reprint, published by James MacLehose & Sons, Glasgow (20 vols., 1905–1907), Vol. 13, p. 359), against the account of Hudson's voyage of 1609 has the reference, "This agreeth with Robert Tyndall." Hudson also speaks of the "Barre of Virginia" at the entrance of "the Kings River," suggesting the sketch map of 1607 or 1608, with "King James his river." He sailed from England on his third voyage March 25, 1609.

[5] The Virginia legend of a western sea persisted certainly to 1621. For Parkinson then reported finding a "china box" or casket in the house of the King of Potomac, "lined in the inside with blue Taffata after the China or East India fashion. They enquiring whence it came the King of Patomecke said, it was presented to him by a certaine people of the Mountaines toward the South-west, who got it from another Nation beyond them some thirtie dayes journie from Patomacke, called Acana Echinae." It may be suspected that Parkinson in writing the spoken word gave it a form suited to his wish, for Echinae too closely reflects his China of the box. But the "continuall constant relations of all those Savages in Virginia, of a Sea, and the way to it West," to which one of the Virginia rivers would give a "safe, easie, and good passage to the South Sea, part by water, and part by Land, esteeming it not above an hundred and fiftie miles from the head of the Falls, where we are now planted," encouraged a hope of "a most rich Trade to Cathay, China, Japan, and those other of the East Indies, to the inestimable benefit of this Kingdome." Purchas, *op. cit.*, Vol. 4, p. 1786 (Glasgow edit., Vol. 19, p. 152).

[6] As reproduced in Brown, *op. cit.*, Vol. 1, facing p. 456, a tracing of a copy of an original.

identification possible. The Velasco map has the King's River, the Prince's River, the Queen's River, and Elizabeth River and carries Chesapeake Bay to its end into an unnamed river. It was made at a time when patriotic feeling and courtly policy gave names intended to flatter and win favor.[7] The courses of the four rivers, even to the branches, are those of the Smith map of 1612; and the islands in shape and location answer to those on Smith. The Indian names of places also correspond, due allowance being made for the vagaries of the engraver.[8] To the west Velasco gives nothing that is not to be found on Smith, and his outlying points are those of Smith. It is evident that Velasco saw an early, perhaps the first, draft of Smith's map before the royal names of rivers had given way to the original Indian names. He sends this copy to his master as a map of Virginia. Any map of the American continent of 1611 would have given the far-flung line of French America, but none save Smith's would have given Virginia in such detail.

The Map Attributed to Smith

We now come to the map which passes under Smith's name, an elaborate and detailed production of the highest historical importance and worthy to stand as a fine example of map making for that time. It embodies the results of a number of surveys, but it is hardly possible that an English draftsman drew the original plan. Were he depending upon a number of sketch plans he would be liable to go astray in piecing them together and to commit grave indiscretions—or worse—in filling in the gaps. There is nothing to show such patchwork; and the draft or plan from which he worked must have been consistent and quite complete in the broad generalizations, leaving to his imagination or practical experience the filling in of the vacant places with suggested or conventional features.

The Smith map was first published in 1612 in connection with the tract "A Map of Virginia," which was written by Smith and to which was appended Symonds' "Proceedings," based upon accounts from Virginia. Among these accounts one from Nathaniel Powell is named. Smith's portion of the tract is at once an encouragement to would-be settlers in the new plantation and a reply to slanderous reports of the land that were being spread by "some bad natures . . . that will slovenly spit at all things, especially in company where they can find none to contradict them."[9] The mention of the map in the tract makes no claim to authorship, nor does

[7] Cf. Hudson's three capes, 1610: Prince Henries Cape, King James his Cape, and Queene Annes Cape. Purchas, *op. cit.*, Vol. 3, p. 599 (Glasgow edit., Vol. 13, p. 382).

[8] This is shown by the places noted on the James River beginning at its mouth, as follows, the first version being according to Velasco, the second according to Smith: Checepiock, Chesapeack; Mattanock, Mattanack; Ile of Hogkes, Hog Ile; Quayonghoohanck, Quiyonghcohanock; Appamatusk, Appamatuck; Massinacach, Massmacack; Monahassanugh, Monahassanugh; Rossawick, Rassawick. Near the end of Chesapeake Bay Velasco has Tacough river. Smith has Tochwogh flu.

[9] "A Map of Virginia," p. 37.

it suggest any immediate agency in its preparation.[10] On the first issue of the map itself the words "Discouered and Discribed by Captayn John Smith" and "Grauen by William Hole"[11] are found under the scale; but in the second issue, or state, the year 1606 has been inserted under the word "Smith."[12] In that form the legend continued unchanged in the nine states following the first, for ten different states have been described.

As engraved, the Smith map shows an advance upon the Zuñiga chart. The Potomac has been explored and properly empties into Chesapeake Bay, and the Bay is carried on to the Susquehannah. Thus was eliminated Smith's pardonable error in believing that in or near Virginia could be found a passage into the western ocean. The last state of the map from the Hole plate was made in 1632; and the alterations and additions between 1612 and 1632, chiefly in place names, were neither numerous nor important. The lines were so fixed that it is easy to recognize the map, even when masquerading in odd forms adopted by other map makers. It was the most authoritative survey of the country yet furnished and had no real predecessor.

The merits of Smith's map were recognized by the best map makers of the Netherlands, but time was required to absorb them and make the new plates. Only in 1628 was there inserted in Mercator's atlas a map—"Nova Virginiae tabvla"—which is the Smith map engraved by a Dutch engraver. Thus sixteen years passed before any trace of Smith is found in the best atlases of the day; then his map was taken bodily, without change.

De Laet in 1630 issued an excellent map of the coast from Nova Scotia to Cape Fear, evidently based upon Smith for Virginia, possibly on Smith for New England, and certainly on the Dutch map for New Netherland. In Mercator of 1631 is the map of America redrawn—"Auct. Henrico Hondio, 1631"—with an inset showing Brazilians omitted and the outline of North America materially changed; but it was not until 1638 that the "America Septentrionalis" gave the coast in approximately its final form. As a Mercator-Hondius atlas, 1636 (Hexham's translation), it gives the Smith map, the earlier "Virginiae Item et Floridae Americae Provinciarum, nova Descriptio," which had first appeared in 1607 and was based upon Bry, and a third map—"Nova Anglia Novvm Belgium et Virginia, Johannes Janssonius, excudit"—which is the De Laet map re-engraved on a larger scale, with additional names of localities to the

[10] *Ibid.*, p. 10. William Strachey wrote his "History of Travaile" about 1616–1618 and noted in the margin "A dew remembrance of Capt. Smyth, vide lib. iii, cap." but never got beyond his second book. Against that marginal note are the words: "their severall habitations are more plainly described by the annexed mappe, set forth by Captain Smith, of whose paines," etc. The lithograph of the map in the Hakluyt Society's issue of the "Historie of Travaile," *Hakluyt Soc. Publs.*, 1st Series, Vol. 6, London, 1849, facing p. 23, is misleading, as it omits the "inset" illustrations, the very feature mentioned by Strachey. Mr. Eames gives the true explanation, that the person making a tracing of the map gave up when he came to the illustrations.

[11] William Hole was one of the earliest of English engravers. Portraits, title pages, and music (he was the first in England to engrave music on copper plates) gave him occupation, but his work is not held in much estimation by collectors.

[12] See below, p. 443, footnote 24.

north. No change occurs in the region of Virginia. After 1630, then, though Smith's map had been fully adopted by the atlas makers, the earlier charts were still retained in the atlases.

No definite claim appears to have been made by any of Smith's contemporaries that the map was actually the work of his hands. It was not known as the work of Smith any more than the early map of Florida was known as the Chiaves map. In each case the plot was associated with the name of the person who had described the region plotted. De Laet, who first published his work in 1625, in the section devoted to Virginia refers to the representation of an Indian on Smith's map, but he does not give Smith's name in connection with it, nor has he a map of Virginia in his volume. Such a map makes its first appearance in the issue of 1630 of De Laet, and it is based upon Smith. In the text De Laet reproduces the Indian figure, but there is still no mention of Smith by name. A Latin translation was printed in 1633, and here Smith does receive credit by name. "Iconem unius barbari Joannes Smithus in tabula sua Geographica nobis expressit, quam hic adjungere operae precium putavi" (p. 79). The French version of 1640 (p. 86) is to the same effect.

Further, no one has claimed or shown that Smith could make a map of quality; he furnished material while employing or directing others to do the actual drafting. The only known example of his ability to draw a plan is the sketch map of the coast of Virginia sent to Lord Bacon in 1618, six years after the elaborate map of Virginia had been engraved by Hole and published. It is inept and almost childish.[13] As not a little depended upon the issue of Smith's application to Bacon, it is somewhat strange that he should have submitted so crude a drawing when the engraved map was to be had.

Some support of this estimate of Smith's ability to draw a map is to be found in the so-called Smith map of New England, which first appeared in 1616, engraved by Simon Van de Pass, who came to England in that year. Compared with the map of Virginia that of New England was simplicity itself, for it is confined to the coast line; and whatever features in the two maps seem alike can be explained by the conventions of map engraving then accepted. Van de Pass was no novice in the art when he made the Smith plate. On the New England map the legend reads "Observed and described by Captayn John Smith." Here again the actual making of the map, that is, the plat form from which the plate was made, is not assigned to Smith's hand.

Powell as the Maker of the Smith Map

The companies which obtained grants in America were anxious to colonize and to receive some returns. One of the first objects was to explore the land and describe its fitness for habitation—the special features which would

[13] Reproduced in Brown, *op. cit.*, Vol. 2, facing p. 596 (second map).

appeal to the adventurer. Surveyors went out in the first ships, and at Jamestown Tyndall was not the only surveyor or map maker. The name of another, Nathaniel Powell, carries weight, though nothing from his hand has been identified. He sailed to Virginia in the spring of 1607 and accompanied Newport in his expedition up the James River. For six weeks in the autumn of 1608 he explored Chesapeake Bay with Captain Smith. He was thus qualified to draw a map of the river and bay. In the absence of any product of his pen, is there any evidence of his work to be found in the printed records? Brown[14] states that a map by Captain Powell of Chesapeake Bay and its rivers was that "probably" sent by Captain John Smith in December, 1608, to accompany "The Relation of the Countries and Nations" printed in the same year as "A True Relation." No proof exists on this point.

In 1641 there appeared in London a tract of four leaves entitled: "A Direction for Adventurers With small stock to get two for one, and good land freely:" etc.,[15] one of the frankly advertising tracts of the period. It was written to a member of the Plowden family by Robert Evelyn, then in Virginia. In this tract, or letter, Evelyn said: "But going to *Delaware Bay*, by Cape May, which is 24 miles at most, and is as I understand very well set out, and printed in Captain *Powels* Map of *New England*, done as is told mee by a draught I gave to M. *Daniel* the plot-maker, which Sir *Edmund* [Plowden] saith you have at home," etc. I have not identified any map maker of that time of the name Daniel. ! John.

In 1648 Evelyn's letter was incorporated in Beauchamp Plantagenet's "A Description of New Albion." The name Beauchamp Plantagenet is suspiciously romantic, but the tract has some merit. In its third chapter Powell's map is again mentioned and in connection with certain well-known printed works: "Which is further witnessed by Captain *Smith* and other books of *Virginia* and by *New Englands* Prospect, new *Canaan*, Captain *Powels* Map, and other descriptions of *New England* and *Virginia*." This sentence forms part of a certificate, apparently drawn before 1641, signed by Evelyn and twelve others endorsing the book as a "true state of the Country, of the Land, and *Delaware Bay* or Charles *River*." Smith's "Virginia" appeared in various issues from 1624 to 1632; Wood's "New Englands Prospect" was printed three times between 1634 and 1639; Thomas Morton's "New English Canaan" was published as from Amsterdam in 1637. All the works named by Evelyn have been identified except the map of Powell. It is stated that at the time the certificate was prepared Evelyn had been "4 years there," and Evelyn went out in 1634. He was therefore no stranger to America.

In one respect Evelyn's statement is confusing, for he speaks of Powell's map of New England. This was a not improbable slip of the pen or con-

[14] *Op. cit.*, Vol. 2, p. 971.

[15] Only two copies of this tract have been located, one in the British Museum and another in the Henry E. Huntington Library, to whose courtesy I am indebted for a photostat copy.

fusion of memory, for in the early seventeenth century the names Virginia and New England were loosely used. No reason can be given for mentioning a map of New England to confirm the outlines of Delaware Bay or the Charles River. No evidence is available to show that Powell was ever in New England, and his prominence in Virginia would preclude a wandering life. He was killed in the massacre of 1622. Evelyn may have meant Smith's map of New England, but it is not likely. For that map was published some time after Smith had left Virginia and when he was not on very good terms with the Virginia Company and its plantation. Taking the double mention of Powell's map as of something quite accessible in print and knowing no other map of Virginia engraved and in print but that which passed as Smith's, I am inclined to advance the claim that Powell, a skilled surveyor, made the plat form, or basis, of the Smith map and is entitled to the credit of it.

Robert Evelyn

Who was Robert Evelyn, on whose uncertain sentences this theory is founded? In April, 1634, Captain Thomas Young, intent upon making new discoveries in America, applied to Secretary Windebank for a royal patent, setting forth that the king had employed him (Young) and his nephew Robert Evelyn in America "upon special and weighty occasions of his Majesty's own particular service, which his Majesty thinks fit should remain private to himself;" with power to leave the king's dominions without any questions. The governors of all colonies in America, particularly of Virginia, were to be instructed "to afford them every assistance, with liberty to traffic in those parts." He proposed also to take with him, as his cosmographer, Alexander Baker, "skilful in mines and trying of metals, at liberty on bond, in regard of some matters on conscience," and another person, Scott by name, as his physician. Knowing the unruly character of seamen of the time he further asked that "some of his principal seamen may be called before a person of authority and charged strictly to obey Capt. Yong and his nephew." He insisted that the articles should be kept "from being seen or known by any."[16] The patent itself echoed so far as it was able these somewhat mysterious and unlimited powers. It stated that the king had been pleased to employ the two men in America, "upon speciall and weighty affaires concerning our private service, whereof we expect a speedy accompt from them. We doe therefore hereby streightly charge and command you and every of you to permitt and suffer the said Capt. Thomas Young, and Robert Evelyn, and theire Company freely to passe and goe, and depart out of anie of our Dominions aforesaid about this our service without any your questions, stoppes, letts, Molestations, pressing interruptions or hindrances in any kind whatsoever. And we do further will and require you and every of

[16] W. N. Sainsbury, edit.: Calendar of State Papers, Colonial Series, 1574–1660, London, 1860, p. 177.

you to give them your best furtherance, ayde and assistance from time to time in theire necessary occasions when and as often as they shall require the same. And hereof you are not [to] faile as you will answere the Contrary at your perills."[17] With such powers Young could have indulged in piracy and claimed the royal protection.

Young must have sailed shortly after receiving his "patent," for on July 3 he arrived in Virginia. Here he attempted to engage a ship carpenter of another vessel, without the consent of the master, which led to an outburst of temper on the part of Captain Matthews, a Virginia magistrate, who said that Young's commission "had not been shewn to him and he knew not whether Yong had any commission or no, and that if things were done in this fashion it would breed ill blood in Va., and so flung away from the Governor in a contemptious and proud manner and turning his back with his truncheon lashed off the heads of certain high weeds that were growing there."[18] All of which was embodied in a statement signed by Young and Evelyn, as well as by Thomas Cornwallis and Thomas Purify, who were present at the altercation. Young built two shallops and about July 25 went upon his voyage of discovery. Nothing more is known of him.

Some six months later we find Lieutenant Evelyn receiving a letter from Governor Harvey of Virginia, to be delivered in person to Windebank,[19] indicating that he was on his way to England. Nothing further is known of him until about January, 1637, when he was appointed surveyor of Virginia in place of Gabriel Hawley deceased, and also a member of the Council. It was stipulated that he was to continue to enjoy the favors granted to him by the king's letters of April 18, 1634.[20] He again went to England in 1640, where his pamphlet or letter we have quoted was printed; but he had already become a resident of Maryland and was commander of Kent Isle and a member of the Assembly of that colony in 1637–1638 and in 1642.[21]

Conclusion

Although grave doubts and suspicions may be awakened by Beauchamp Plantagenet's somewhat stagey name and rambling book, the person and letter of Evelyn are authentic. He was familiar with Virginia and had succeeded to its surveyor's office, with its possible records of what had been done by his predecessors. He speaks of Powell's map as in print and with no such emphasis as would indicate that the map was more difficult of access than the publications he named with it. Perhaps there was a recognized tradition in Virginia that Powell did make the map of 1612; and memory of origin would be more likely to persist in

[17] Helen Evelyn: History of the Evelyn Family, With a Special Memoir of William John Evelyn, M.P., London, 1915, p. 533. The patent was dated April 18, 1634.

[18] *Virginia Mag. of History and Biography*, Vol. 8, 1900–01, pp. 156–157.

[19] *Ibid.*, p. 161.

[20] Sainsbury *op. cit.*, p. 244.

[21] *Virginia Mag. of History and Biography*, Vol. 9, 1901–02, p. 172, note.

the colony than in England. Certainly if the Smith map held a supremacy in Europe for thirty years, it must have done so because no better map had been made, and the existence of a better map would have been known in Virginia by its official surveyor. We have evidence that as late as 1659 the Smith map was regarded as authoritative. In that year, when the Dutch representative, Herrman, came to Maryland, Secretary Calvert showed him some maps of Virginia: "two that were engraved and one in manuscript. One was printed at Amsterdam, by direction of Captain Smith, the first discoverer of the great bay of Chesapeack, or Virginia; the second appeared also to be printed at Amsterdam, at the time of Lord Balthamoer's patent; we knew not by whom or where the manuscript one was drawn. All differed, one from the other."[22] Again is curiosity excited by the statement that a map of Virginia was printed in Holland "by direction of Captain Smith." No such map is known, though the Hole plate may have been sent to Holland; or Herrman may have seen a Smith map as it was printed for a Dutch atlas, the name of engraver or printer being upon it; or, finally, "direction" may have been intended for "description," a word on the Smith map. The Cecil map is in "A Relation of Maryland," 1635, labeled "Noua Terrae—Mariae tabula," intended to show the northern part of Virginia "for the better description of the entrance into the Bay of Chesapeack." It is frankly based on Smith's map, but English names of localities predominate in the region covered by the grant to Lord Baltimore. The engraver, Thomas Cecil, best known for his portraits, was in estimation at the time, and he "has the credit, rare in artists of his period, of being an Englishman."[23] Herrman's statement is a bit of evidence that to 1659 no map of Virginia had been published that would take the place of Smith's as a better representation, and 1659 was eleven years after the year of Plantagenet's tract on New Albion. Herrman knew a map, for he could make one (he prepared a map of Maryland and Virginia, published in 1670).[24]

Slight as the evidence is, it serves in my opinion as a suggestion, and I believe that a question may be raised on the actual maker of the map that has passed under Smith's name. I make the suggestion in the hope that it may lead to investigation by others.

[22] Augustine Herrman: Journal of the Dutch Embassy of Maryland, 1659, in C. C. Hall, edit.: Narratives of Early Maryland, 1633–1684 (Original Narratives of Early American History), New York, 1910, pp. 314–333; reference on pp. 323–324.

[23] Dictionary of National Biography, Vol. 9, p. 405.

[24] As late as 1735 the map attributed to Captain John Smith was used as one of the sources of "A Map of Virginia according to Captain Iohn Smiths Map Published Anno 1606 Also of the Adjacent Country called by the Dutch Niew Nederlant Anno 1630 by Iohn Senex 1735" accompanying the tract "A Short Account of the First Settlement of the Provinces of Virginia, Maryland, New-York, New-Jersey, and Pensylvania, by the English." This tract deals with the famous boundary dispute between Pennsylvania and Maryland that lasted from 1681 to 1760. It was reprinted with John Senex' map by the American Geographical Society in 1922. The date 1606, attributed by John Senex to Smith's map, should, of course, read 1612 and is due to the insertion of the year "1606" under the word "Smith" in the second and subsequent states of the Smith map (see above, p. 438). In the circular describing the American Geographical Society's reprint the date of Smith's map is erroneously given as 1606.—EDIT. NOTE.

RECENT CONTRIBUTIONS TO URBAN GEOGRAPHY: A REVIEW

By M. Aurousseau

City geography is a comparatively recent phase of specialization. In so far as it embraces a large section of the field of human geography it is not specialization at all. To produce results of value, however, it calls for a type of student rare in the physical sciences; a type endowed with imagination almost of an artistic kind, but restrained in a rigorous way by the discipline of scientific method. The city has to be interpreted as an organic part of a social group, as well as described as a mass of materials. In this way the study is a special one, for the capable exponent is an unusual type of person.

Growth of the Subject

Oberhummer and Hassert gave the subject its first general foundations in 1907.[1] Discursive work had been done in abundance before that date, but almost up to the present time Hassert's admirable little book has been the only general work on the geography of towns. Prior to the publications of these works an important effort had been made in Dresden to understand the life and significance of the large town from a geographical point of view. The results, if somewhat one-sided, are still informative.[2]

During the period 1907–1913, when human geography was in lively growth, urban geography made rapid strides. The works of Blanchard on Grenoble and of Levainville on Rouen then appeared.[3] They remain the high level of performance, nothing of their scope and thoroughness having been produced since then. During the war years research activity in urban geography almost vanished. The subject received its due recognition, however, in 1919, when the journal *La Vie Urbaine* first made its appearance, and just recently Geisler brought matters up to date, at any rate so far as Germany is concerned, in two very able papers of general bearing.[4]

[1] Eugen Oberhummer: Der Stadtplan, seine Entwickelung und geographische Bedeutung, *Verhandlungen des XVI deutschen Geographentages zu Nürnberg, 1907*, Berlin, 1907, pp. 66–101.

Kurt Hassert: Die Städte geographisch betrachtet, Leipzig, 1907.

[2] Die Grossstadt. Vorträge und Aufsätze zur Städteausstellung (7 papers by different writers). *Jahrbuch der Gehe-Stiftung zu Dresden*, Vol. 9, 1903.

[3] Raoul Blanchard: Grenoble: Étude de géographie urbaine, Paris, 1911 (2nd edit., 1912). Reviewed in *Geogr. Rev.*, Vol. 3, 1917, pp. 243–244.

Jacques Levainville: Rouen: Étude d'une agglomération urbaine, Paris, 1913.

[4] Walter Geisler: Beiträge zur Stadtgeographie, *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1920, pp. 274–296. Reviewed in *Geogr. Rev.*, Vol. 11, 1921, pp. 614–616.

Idem: Die Deutsche Stadt: Ein Beitrag zur Morphologie der Kulturlandschaft, *Forschungen zur deutschen Landes- und Volkskunde*, Vol. 22, 1919–1924, pp. 359–552.

Method of Study

Only one paper dealing specifically with method in urban geography is so far available.[5] The author, Blanchard, is perhaps the most able worker in the field. He considers the four major partitions of the research to be situation, site, history, and the existing city. The nature of the investigation on the spot is quite specifically outlined. In the hands of Blanchard and his students the method has proved to be eminently successful. To his technique may be added the use of aerial photographs, as recommended by Joerg,[6] an adjunct of remarkable utility in the investigation of American cities, maps of which seldom show the built-up areas. We may also suggest the need of studying the city at night or on holidays, when the people are not at work. The areas deserted at such times are significant, from the point of view of business distribution and dwelling density. The core of New York is, for example, impressively still on Sunday evenings.

Regional Study

It is an astonishing fact that the greatest interest has centered upon the individual town. Geography is so deeply concerned with the distribution of things that an interest in town distribution seems to be an obvious consideration. Little attention has been given to it. An inspection of the plans of Peking, Teheran, Bologna, and Washington, for example, is enough to suggest that the town shows a kind of racial, or national character, in its form and aspect. Reclus published a number of excellent town maps that are very informing in this respect,[7] and some of Ratzel's work is suggestive[8]; but Fleure is the only active student of the regional character of the town.[9] The general distribution and size of towns has caught Jefferson's attention. He uses a set of symbols indicative of size and evidently considers that towns, from small to large, form a graded series.[10] I hope shortly to produce the results of a study of the sizes of towns that will carry the matter a step further. Obviously then, the distribution of towns is an almost open field for investigation.

Functional Study

The functional importance of the urban group receives its full due in certain French researches to which reference will subsequently be made.

[5] Raoul Blanchard: Une méthode de géographie urbaine, *La Vie Urbaine*, Vol. 4, 1922, pp. 301–319.

[6] W. L. G. Joerg: The Use of Airplane Photography in City Geography (abstract), *Annals Assoc. of Amer. Geogrs.*, Vol. 13, 1923, p. 211.

[7] Elisée Reclus: Nouvelle géographie universelle: La terre et les hommes, 19 vols., Paris, 1876–94.

[8] Friedrich Ratzel: Die geographische Lage der grossen Städte, pp. 437–461 of Vol. 2 of Hans Helmolt, editor, Kleine Schriften von Friedrich Ratzel, 2 vols., Munich and Berlin, 1906.

[9] H. J. Fleure: Some Types of Cities in Temperate Europe, *Geogr. Rev.*, Vol. 10, 1920, pp. 357–374. See also Robert Gradmann: Schwäbische Städte, *Zeitschr. Gesell. für Erdkunde zu Berlin*, 1916, pp. 424–457.

[10] Mark Jefferson: Some Considerations on the Geographical Provinces of the United States, *Annals Assoc. of Amer. Geogrs.*, Vol. 7, 1917, pp. 3–15.

Idem: The Distribution of People in Japan in 1913, *Geogr. Rev.*, Vol. 2, 1916, pp. 368–372.

Idem: The Distribution of British Cities, and the Empire, *ibid.*, Vol. 4, 1917, pp. 387–394.

Idem: Great Cities of the United States, 1920, *ibid.*, Vol. 11, 1921, pp. 437–441.

As a general subject for study, however, little has so far been done. The reception given to Vaughan Cornish's book on capital cities, both in technical journals and in the contemporary press, shows how eager is the desire for information of this kind.[11]

Marinelli has made a statistical examination of certain Italian and American cities, according to the occupations of the inhabitants as shown by the census.[12] He finds that in many cities, significantly in small cities and towns, there is a dominant occupation that places the city definitely in a functional classification. The occupational analysis of the large city shows no such clearly marked character. This leads him to tabulate a group of large cities as "unspecialized types." Actually these are the most highly specialized of economic agglomerations. They are cities where professionalism, commerce, and industry are interwoven in relations of a metropolitan kind.

The Status of the Town

Society is organized on an economic basis. The units that develop in order to conduct the affairs of modern life are thus economic necessities. In geography we use the terms town, city, and metropolis in an arbitrary manner, according to the size, nature of administration, or apparent importance of the unit. Urban units, however, are strictly aligned with particular grades of economy and seem to embrace different geographic forms, perceptible to the initiate, though as yet undefined. Attention must here be directed to a kind of work likely to be of fundamental importance in urban geography.[13] It indicates clearly that the metropolis, the industrial town, and the commercial town must be treated as different geographic entities—forms in human geography, analogous, in their expression of social and economic processes, to the land forms of the physiographic processes. The metropolis, the great unit that organizes business for a wide metropolitan area, or hinterland, may even now be clearly envisaged. Extensive work is needed before the metropolis can be defined, while the forms of lower status are as yet but dimly visible in the sunrise.

The Metropolis

The great cities that can even now be accepted beyond doubt as metropolitan have been given no unified geographic interpretation. To be sure, their advantages of position are well understood. I have seen a textbook of elementary general science that made the situation of Chicago perfectly clear. But where is there an adequate work on the geography of Chicago,

[11] Vaughan Cornish: The Great Capitals: An Historical Geography, London and New York, [1922]. Reviewed in *Geogr. Rev.*, Vol. 14, 1924, pp. 156–157. On the functional aspect of city geography see also M. Aurousseau: The Distribution of Population: A Constructive Problem, *Geogr. Rev.*, Vol. 11, 1921, pp. 563–592, especially p. 572.

[12] Olinto Marinelli: Dei tipi economici dei centri abitati a proposito di alcune città italiane ed americane, *Riv. Geogr. Italiana*, Vol. 23, 1916, pp. 413–431.

[13] N. S. B. Gras: An Introduction to Economic History, New York and London, 1922. Reviewed in *Geogr. Rev.*, Vol. 14, 1924, pp. 161–163.

Paris, or Rome? The time is hardly ripe. Every metropolis has a large, if not tremendous, bibliography. The geography of the form is growing piecemeal and by attack from various angles. Here and there a solid co-ordination of results has been effected. But the geographer can produce no rounded contribution until the historian, the economist, and the engineer, to name but a few, have spoken clearly. He will not, on this account, be a mere parasite on the work of others. He must make his own extensive investigation, with its peculiar technique, on the spot and will shed on the contributory work of others an entirely new light. Metropolitan geography is incomplete, but distinct advance has been made in two cases—London (Registration London, 4,483,249 in 1921)[14] and Berlin (Greater Berlin, 3,803,770 in 1919).[15] It seems evident that metropolitan geography will be produced by synthesis rather than by individual effort.

The City and Town

Attention has centered on the city through a general and long sustained interest in its situation. Geographical literature is besprinkled with brilliant little notes and paragraphs explaining the position of this or that place, to the extent that most of the important cities of Europe have been thus "explained."[16]

Human geography, however, opened up a vast field and has led us to look closely at every detail of the town or city. It is evident here too, from the work done, that the town or city of more than 500,000 inhabitants is too great a task for a single investigator, even if provided with a library of antecedent contributory results. Rouen and its *banlieue* (to the limit of suburban tramway communication) had a population of 183,066 at the time of Levainville's investigation. If the geography of the metropolis is to be effected by synthesis, it seems that good results may be obtained for the large city by a method of symposium. Edinburgh (420,281 in 1921) and Glasgow (1,034,069 in 1921) have been dealt with in this way[17] though not completely. Other examples will be given later.

Specific Examples: Cities

Recent geographical work has been more particular than general. It has been directed towards the history of the origin and growth of the town to its present form, on the one hand, and towards internal modification of aspect on the other. Of the general kind of study we may note in passing

[14] Population statistics, unless otherwise indicated, are taken from the "Statesman's Year-Book," for 1923. They refer to the city as recognized by the Census.

[15] See the article London: A Geographical Synthesis, *Geogr. Rev.*, Vol. 14, 1924, pp. 310–312. See also Beiträge zur Geographie Berlins (five papers by different writers), *Mitt. des Vereins der Studierenden der Geographie an der Universität Berlin*, No. 2, 1918.

[16] For the more important literature of "situation" see Aurousseau, *op. cit.*, pp. 568–575.

[17] See the "Edinburgh Number" of the *Scottish Geogr. Mag.*, Vol. 35, 1919, August-September-October, pp. 281–330; and the "Glasgow Number," *ibid.*, Vol. 37, 1921, January, pp. 1–80. Noted in *Geogr. Rev.*, Vol. 11, 1921, pp. 298–299.

a paper on the ancient capitals of Japan.[18] It is a contribution to history rather than geography but calls for notice, as it places a great amount of material in the hands of western students. Being concerned with the progressive migration of capitals during the era of conquest of the islands, it is a useful supplement to Vaughan Cornish's interpretation of Japanese capitals.[19] No attempt will be made here to give a complete summary of particular work, but a few of the most interesting examples will be indicated.

Lille is the largest city to have received satisfactory attention. The city, with its *faubourgs* and *banlieue rurale*, had a population of 385,256 in 1914. The work is the result of several studies,[20] which enable the city to be visualized and appreciated as a living thing in the light of its development and relations. The geography of Lille, nevertheless, is far from complete, the internal geography apart from certain considerations of the core itself being almost untouched. Scrive-Loyer prefaced his earlier work by a general chapter on city geography wherein he shows the importance of the fusion of potential city nuclei in the development of large agglomerations (London and Westminster are the grand example). He also enters into a discussion of the vexed question of the suburbs, distinguishing the *faubourgs*, prolongations connected directly with the built-up city proper, from the *banlieue rurale*, which produces fresh perishables and over which the city exercises special rights. Making extensive use of Blanchard's work, he shows that Lille, from the earliest times, has been a richly favored interregional town, with marked advantages both of site and situation. It has constantly turned a higher grade of advantage to account and stands now at a great European crossroads, close to an important coal field, and midway between the iron fields of Normandy and Lorraine.

Marseilles (586,341 in 1921), though a greater city than Lille and the subject of two significant investigations,[21] has not yet been clearly interpreted. Blanchard has given a most illuminating summary of the geographical setting of the city, which touches all sides of the subject, but it does little more than touch them. His primary intention was to review. Rambert's long paper is an extensive historical and physical statement but hardly deals with the life of the place at all. Not until he comes to a discussion of architecture and house types does the reader feel that the subject is being handled in a vital way. Marseilles is singular in its isolation. It is placed at a point offering the meager, but best, advantages in

[18] R. A. B. Ponsonby Fane: Ancient Capitals and Palaces of Japan, *Trans. and Proc. Japan Society, London*, Vol. 20, 1922–23, pp. 105–217.

[19] Cornish, *op. cit.*, pp. 264–271.

[20] Raoul Blanchard: La Flandre, Paris, 1906, pp. 436–443.

Idem: Deux grandes villes françaises, Lille et Nancy, *La Géographie*, Vol. 30, 1914–15, pp. 103–122.

Jules Scrive-Loyer: Les conditions anthropogéographiques du développement de l'agglomération lilloise, *Bull. Soc. de Géogr. de Lille*, Vol. 63, 1921, pp. 143–162, 199–226, and 279–308.

Idem: L'agglomération lilloise: Étude d'aménagement et d'extension, *La Vie Urbaine*, Vol. 5, 1923, pp. 415–441.

[21] Raoul Blanchard: Trois grandes villes du sud-est [Lyons, Marseilles, Nice], *Recueil des Trav. de l'Inst. de Géogr. Alpine*, Vol. 6, 1918, Grenoble, pp. 153–210.

Gaston Rambert: L'agglomération marseillaise, *La Vie Urbaine*, Vol. 1, 1919, pp. 311–328 and 469–483; Vol. 3, 1921, pp. 245–271 and 347–367.

a "zone of difficulty."[22] The situation enables it to serve the traffic problem of southern France as no other place can, but there is no hinterland to the town. The site, advantageous enough in the beginning, has offered many obstacles, which have been removed or circumvented at great cost and by enormous effort. This place, really meagerly endowed but the best on a forbidding coast, has been able to establish itself as an *entrepôt*. Thus from commercial activity it has risen to industrial rank by working over the variety of merchandise and products brought across land and sea to its quays. Marseilles enjoys a relative superiority of emplacement that makes Genoa the only possible rival. Thanks to the superiority of artificial harbor works, Marseilles will keep its ascendency.

These two cities then, Lille and Marseilles, illustrate the method of symposium applied to large agglomerations. The geography of the city is expressed by the bringing together of several contributions that are specifically geographic in their intent. First contributions have been made for a few other major cities. Blanchard has reviewed Lyons (561,592 in 1921), Nice (155,839 in 1921), Bordeaux (267,409 in 1921), Nancy (113,226 in 1921), and several other cities.[23] Dubois has similarly expressed Antwerp (304,124 in 1921), as the culminating development of Flemish life; Brussels (775,039 in 1921), as the great crossroads on a fundamental ethnic boundary; and Liége (165,136 in 1921), as the workshop of Walloon craftsmanship.[24]

First contributions have also been made for Leipzig (604,380 in 1919) and Lübeck (113,746 in 1919), and some useful material has been placed on record for Cologne (633,904 in 1919).[25] The Cologne papers, indeed, actually form a symposium, but their purpose and main content is somewhat far from being geographical in its nature.

It is more than likely that some of the cities just mentioned will eventually be found to have metropolitan status, while those of the lower order of magnitude could have been dealt with thoroughly had the opportunity been afforded to their respective investigators. The works now to be noted indicate that the task is not too formidable for a single, unaided worker.

Walter Geisler has completed an extensive research on Danzig (194,953 in 1923), wherein he shows how a preëminent site has been put to

[22] See H. J. Fleure: Human Regions, *Scottish Geogr. Mag.*, Vol. 35, 1919, pp. 94–105.

[23] Blanchard, Trois grandes villes du sud-est.

Idem: Deux grandes villes françaises, Lille et Nancy.

Idem: Bordeaux, *Rev. de Géogr. Commerciale*, Vol. 43, 1917, Bordeaux, pp. 323–337.

[24] André Dubois: Trois cités belges: Liége, Anvers, Bruxelles, *Bull. Soc. de Géogr. de Lille*, Vol. 64, 1922, pp. 66–86.

[25] Hans Rudolphi: Das Stadtbild Leipzigs geographisch betrachtet, *Mitt. des Vereins der Geographen an der Universität Leipzig*, Vol. 1, 1911, pp. 14–35.

Christian Reuter: Der Aufbau der Stadt Lübeck von der ältesten Zeit bis zum vorläufigen Abschluss der Entwicklung um das Jahr 1300, *Zeitschr. des Vereins für Lübeckische Geschichte und Altertumskunde*, Vol. 12, 1910, pp. 3–27.

Köln (eleven papers by various writers), *Mitt. des Rheinischen Vereins für Denkmalpflege und Heimatschutz*, Vol. 5, 1911. See also Walther Tuckermann: Die geographische Lage der Stadt Köln, *Pfingstblätter des Hansischen Geschichtsvereins No. 14*, Lübeck, 1923.

intensive use and how the city, once established, has availed itself of all regional advantages one by one until, in order to maintain its status, it has had to regulate or overcome the disadvantages of the site. His contribution to method is a map showing the heights and uses of buildings within the core of the city.[26] Similar work has been done for Bremen (269,806 in 1919)[27] and Stettin (232,726 in 1919).[28] These studies are balanced in their treatment and have a definite quantitative stamp. They lack the lively spiritual understanding so evident in French work, being formally descriptive rather than vividly interpretive. They should be compared with Levainville's work on Rouen (123,712 in 1921), a city of the same class (see above, note 3).

Riga (185,137 in 1920) has been made the subject of an important study, already noted in this journal.[29] This contribution is unique in its attempt to give a conception by map of the hinterland of the port. The effects of topography and land ownership on the growth of the town have also been dealt with in an illuminating way.

A recent piece of work of slender proportions calls for attention here. Friedrich Leyden[30] by means of Heim's device of printing on both sides of a map and then using it as a transparency, is able to show a close connection between the growth of Ghent (165,287 in 1921) and its geological foundation. In the text he draws a contrast with other Flemish cities in showing that Ghent had no great market place but rather a series of markets; it had no great open spaces and hence had an exceptionally low dwelling density. Quite unconsciously he hits what are perhaps two generalizations. We owe to Geisler a realization of the conservatism of streets. Leyden, endeavoring to map the growth of Ghent according to periods, has realized the conservatism of street names. In tracing from street names the quarters belonging to remote periods, he has been forced to use the philology of suffixes—a method applied in Belgium by Marguerite Lefèvre also. Again, Ghent has few thoroughfares. The canal net and meanders of the Leie and Scheldt suffice for a large part of the heavy work of transportation throughout the city. This should be a feature of other "waterway" cities.

The Small City

Particularly modern in treatment is Levainville's paper on Caen (53,743 in 1921)[31] because of its rigorous application of economic history. The *campagnes* and *bocages* of Basse Normandie are a group of well-defined natural regions that have borne a diversified culture, based on the

[26] Walter Geisler: Danzig: Ein siedlungsgeographischer Versuch (diss.), Halle, 1918.
[27] Theodor Biehl: Bremen: Eine landschaftskundliche Stadtuntersuchung, Bremen, 1922.
[28] Hans Kröcher: Stettin: Ein Beitrag zur modernen Stadtgeographie (diss.), Greifswald, 1913.
[29] Richard Pohle: Riga, *Meereskunde*, Vol. 13, No. 8, 1920. Reviewed in *Geogr. Rev.*, Vol. 10, 1920, pp. 344–345.
[30] Friedrich Leyden: Gent, *Petermanns Mitt.*, Vol. 69, 1923, pp. 67–69.
[31] Jacques Levainville: Caen: Notes sur l'évolution de la fonction urbaine, *La Vie Urbaine*, Vol. 5, 1923, pp. 233–278.

soil, from very early times. Drainage lines make Caen the natural focal point for the traffic of this hinterland and place it in easy touch with neighboring regions. Nevertheless, no sure trace of a Saxon town can be found. The Normans used the site; but when the city first appears in history (in the eleventh century) it does so as an established foundation. It was a town devoted to marketing but was satellitic in its activities to Rouen, to which it lost its fairs (1476). Owing to varying fortunes and irregular development it did not enter into definite commercial relations until the beginning of the sixteenth century. Thence on, to the third quarter of the nineteenth century, its character hardly changed. Caen was a town in the commercial phase, handling the goods of its region well, exporting them to the Netherlands and England, and importing combustibles, wines, etc. Small industries existed, based on the products of the hinterland; but the town was essentially commercial, conservative, and unchanging. In 1873 investigation proved the existence of great reserves of high-grade, bedded hematite and siderite in the Silurian near Saint-Rémy. The ore had special uses. The fate of Caen was sealed. German capital started the exploitation, and the town stepped into the industrial phase. The port was improved, furnaces and works were erected, and traffic increased. The hinterland supplied some labor, the rest was recruited from without. Iron went abroad, and coal came back. Caen and its region are now profoundly altered. The sectionalized market town has become an integrated industrial agglomeration with an assured prosperity, and the old Caennais deplore the change. From 41,181 inhabitants in 1876 to 53,743 in 1921 is a stride, but Caen remains a town. The great neighboring city of Rouen diffuses an influence (largely financial) throughout its region, that Caen will not attain. "En Basse Normandie la vie monte de la terre; elle ne descend pas de l'usine." A prettier example of town economy would be hard to find.

Here too, in the class of small cities that are economically towns, belong such studies as Blanchard's Grenoble (77,409 in 1921) and certain papers in recent numbers of *La Vie Urbaine*, like that of Marcel Poëte on Besançon (55,652 in 1921).

Biermann's work on Lausanne (68,533 in 1920) calls for brief mention, as it illustrates particularly well the conservatism imposed upon many European towns by the period of defense of the Middle Ages.[32] The Roman foundation occupied an even space close to the lake shore on the small alluvial plain, the natural nodal point of regional routes. In the Middle Ages the town was forced to occupy a defensive position to the northwest of the smooth ground. Lausanne has since moved downhill; but the heart of the town is still determined by the fortress position, and only the modern extensions are spreading westward over the alluvial land.

[32] Charles Biermann: Situation et site de Lausanne, *Bull. Soc. Neuchateloise de Géogr.*, Vol. 25, 1916, pp. 122–149. Reviewed in *Geogr. Rev.*, Vol. 6, 1918, p. 285.

The Town

If the city and the small city have their respective classical monographs on Rouen and Grenoble, the little Galician town of Biala (8257 in 1900) has also been the subject of exhaustive treatment.[33] The method of approach here is very like that of Blanchard. Hanslik's work is particularly interesting in two ways: he shows the relations of the situation of Biala not only with regard to regional physiographic features but also with reference to important cultural boundaries; he also pays meticulous attention to the internal geography of the town.

For work of comparable importance, one must turn to the results of the energetic Grenoble school. The provincial geographic journals of France contain fairly numerous references to the geography of the small town,[34] but the work is superficial and slight. The Grenoble results, however, mark an important phase of progress. Four towns have been studied so far, each one in a thorough manner. The treatment is uniform, though by no means monotonous. The results themselves are of the greatest local interest and importance but do not yet afford grounds for generalization. As examples of procedure, however, they should claim the careful attention of the student of city geography. The four towns are Annecy (Haute Savoie, 17,241 in 1911),[35] Albertville (Savoie, *total* population 10,278 in 1911; 7320 in 1921),[36] Briançon (Hautes Alpes, 7888 in 1911; 5012 in 1921),[37] and Annonay (Ardèche, 14,876 in 1921).[38] All these works on the small town are notable for their length and their wealth of illustrations and maps.

Studies Allied to Town Planning

Town planning has a voluminous and growing literature. It is not my intention to deal with it here otherwise than to indicate it as a source of useful cartographic material. As a subject it separates itself clearly enough from city geography but may by no means be ignored. Certain studies have been made in the realm of town planning which have a distinctly geographic character.

First place must be given to the "English Catalogue, International Cities and Town Planning Exhibition, Jubilee Exhibition, Gothenburg, Sweden, 1923." This profusely illustrated work is a mine of geographical information. Arranged according to participant countries, many sections are prefaced by a statement, from the pen of an authority, on the condition of towns and cities in the countries concerned, dealing often with post-war

[33] Erwin Hanslik: Biala, eine deutsche Stadt in Galizien, Vienna, Teschen, and Leipzig, 1909.

[34] See for example P. Collesson: Grasse, ville des parfums, *Bull. Soc. de Geogr. de l'Est*, Vol. 30, 1909, pp. 232–240.

[35] Raoul Blanchard: Annecy: Esquisse de géographie urbaine, *Recueil des Trav. de l'Inst. de Géogr. Alpine*, Vol. 4, 1916, Grenoble, pp. 369–463.

[36] F. Gex: Albertville: Étude de géographie urbaine, *Rev. de Géogr. Alpine*, Vol. 9, 1921, Grenoble, pp. 5–134.

[37] Henry Petiot: Briançon: Esquisse de géographie urbaine, *ibid.*, Vol. 9, 1921, pp. 341–456.

[38] F. Thomas: Annonay: Essai de géographie urbaine, *ibid.*, Vol. 11, 1923, pp. 117–199.

circumstances. It is impossible to summarize the work, but it is recommended as a source book of urban geography. Of general bearing, too, is an article by Dario Barbieri.[39] He discerns the germs of rectilinear or radial plan in the cores of most Italian cities and is led to a discussion of the regular plan. He deplores the nineteenth century Italian outgrowth and makes an esthetic appeal for better town planning. Some informing plans accompany the article. The author regards the problem as having organic, technical, and artistic sides and thinks the solution is a kind of local expression of the threefold exigencies. Interesting examples are given.

Along the line of specific effort, the scheme for "the garden girdle of Kiel" will be watched with interest.[40] Kiel, Bremen, and other places in North Germany express their zeal for outdoor exercise by gardening. The effort increases the food supply. Kiel intends to turn this taste of its citizens to account by a zoning scheme. The industrial and residential sections of the city are to be regulated; the existing gardens, public and private, are to be extended, allowing for forest and park reserves, and the city will ultimately feed itself by its own effort. All is calculated to a nicety. City refuse will be deflected inland, by an extensive canal, pumping, and treatment system; water conservation will be undertaken; model gardens will be established; tool factories will operate; an agricultural society will be formed; prices will be regulated, etc. It is an extension of existing activities and gives fair promise of success. Of a different character is the "Report of the South Wales Regional Survey Committee" (Ministry of Health, London, 1921). Life in the urbanized area of the South Wales coal field is here examined critically with a view to its betterment. The recommendations of the committee are numerous but systematic. First, administrative boundaries must be resurveyed, in order that local authority may act more efficiently in the co-ordination of existing public facilities and communications. Secondly, units must be developed in the area at suitable places, for example a dormitory town at Llantrisant and a health resort at Porthcawl. All details of local congestion, water supply, health conditions, recreational facilities, and housing have been examined. The siting of houses with reference to topography and local weather conditions is especially interesting. If the recommendations are carried into effect the scheme will be so large as to take the character of "country planning."

City Geography in Scandinavia

The Stockholm center has long been noted for its contributions to demographic geography. The interest there is turning steadily to human geography, and, from information we have received, considerable advance has been made in the study of Swedish cities. A paper has already appeared

[39] Dario Barbieri: I piani regolatori e la fisonomia delle città, *Le Vie d'Italia*, Vol. 29, 1923, pp. 875–885.
[40] La ceinture agricole de Kiel, *La Vie Urbaine*, Vol. 5, 1923, pp. 443–450.

on Stockholm (419,440 in 1920).[41] The Danish statistical bureau publishes maps that enable the extent of the larger agglomerations to be determined,[42] and the Norwegian bureau makes occasional contributions to the problem of city population.[43] The general interest in the city problem in these countries and in Finland is bound to result in valuable contributions to city geography in the near future.

City Geography in the United States

North American interest has centered in the population geography of cities rather than in the broader questions of city geography.[44] Notable contributions have been made on several occasions by visitors to the country, the main point to receive attention being the comparison of American with European cities. During the Transcontinental Excursion of 1912 of the American Geographical Society four papers were presented by visitors dealing with various sides of city geography, one of which calls for special notice of this point.[45]

The geographical journals of the United States contain numerous articles on the geography of cities wherein the locational interest is dominant. Very seldom does a work of depth on the geography of a particular city appear. There are scattered papers on New York, and notes have appeared on nearly all the larger cities; but intensive studies are rare. There are nevertheless some notable contributions.[46] Coming to particular cities we find few that claim a written geography. For Chicago (2,701,705 in 1920), the ground has been broken by the local geographic society[47]; while certain students have shown sustained interest in New Orleans (387,219 in 1920)[48] and Duluth (98,917 in 1920).[49] Another city that has received fairly extended treatment is San Francisco (506,676 in 1920).[50]

The reasons for the lack of extended studies in the United States are to be found in the magnitude of the problem. The country is preëminently one of great cities, each class of city overshadowing in size the

[41] Sten De Geer: Greater Stockholm: A Geographical Interpretation, *Geogr. Rev.*, Vol. 13, 1923, pp. 497–506.

[42] Danmarks Statistik, *Statistiske Meddelelser*, Series 4, Vol. 63, 1921.

[43] A. N. Kiaer: Befolkningstilvekst i Kristiania og Aker, *Norges Officielle Statistik, Meddelelser*, Vol. 31, 1913, pp. 49–63.

[44] Mark Jefferson: The Anthropography of Some Great Cities, *Bull. Amer. Geogr. Soc.*, Vol. 41, 1909, pp. 537–566; also references cited in footnote 10.

L. V. Roth: The Growth of American Cities, *Geogr. Rev.*, Vol. 5, 1918, pp. 384–398.

[45] Eugen Oberhummer: Amerikanische und Europäische Städte, in Memorial Volume of the Transcontinental Excursion of 1912 of the American Geographical Society of New York, New York, 1915, pp. 163–184.

[46] See the "Boston Number" of the *Journ. of Geogr.*, Vol. 2, 1903, June, pp. 271–342 (six papers by different writers); and a group of eight papers by different writers on selected cities of the United States, *ibid.*, Vol. 21, 1922, September, pp. 205–241.

[47] See *Bull. Geogr. Soc. of Chicago*, No. 1 [1913?] and No. 4 [1914].

[48] E. F. Campbell: New Orleans in Early Days, *Geogr. Rev.*, Vol. 10, 1921, pp. 31–36.

Idem: New Orleans at the Time of the Louisiana Purchase, *ibid.*, Vol. 11, 1921, pp. 414–425.

Idem: The Port of New Orleans, *Journ. of Geogr.*, Vol. 20, 1921, pp. 337–350.

[49] Eugene Van Cleef: A Geographic Study of Duluth, *Bull. Amer. Geogr. Soc.*, Vol. 44, 1912, pp. 401–417 and 493–506; and other articles in the *Journal of Geography*.

[50] Alfred Rühl: San Francisco, in Memorial Volume of the Transcontinental Excursion of 1912 of the American Geographical Society of New York, New York, 1915, pp. 287–311 (in German).

corresponding class in Europe. And the great city in Europe has so far yielded a similar harvest of results—interpretations that are incomplete. We must admit, however, that the European work has been more extended and more penetrating. In this land of giant towns the student would do well to apply his first efforts to the small city, extending at a later date to the large city the results of a simpler experience. The outlook for the United States, however, is most encouraging. There is a lively interest in the subject, and a recent supplement to the *Annals of the Association of American Geographers* announces that eight graduate students at present proceeding to the doctorate are engaged upon various phases of work in city geography.

RECENT AMERICAN WALL MAPS: A REVIEW*

By W. L. G. Joerg

The development of American-made educational wall maps may be said to be of fairly recent date. Passing over Guyot's excellent series of relief wall maps of the sixties, which was rather a direct transplantation of the European school as represented by Karl Ritter than a native American product, the earlier efforts do not go back much farther than the nineties, as exemplified by the Columbia political and physical series[1] and by the Franklin relief series. In general they were not much more than enlargements of small maps and lacked the essential qualities of wall maps—boldness and generalization. The modern period begins with Professor J. Paul Goode's series, published in 1913–1917, which has been discussed at length in these pages.[2]

The maps here under consideration represent the first full tide of the modern period—no less than 151 maps published within a period of seven years. Of the eight series to be discussed six are historical. This does not diminish their geographical interest, for they all reflect the tendencies of the "new" history, with its broader conception of the subject as the history of civilization and its consequent emphasis on geographic conditions and economic development. Indeed history, when using so preëminently geographical a medium of expression as maps, is perforce strongly oriented towards geography. In the fields of ancient and European history these series follow well-trodden paths; excellent European, especially German, wall maps and atlases have long been available. In these subjects the main

* J. H. Breasted and C. F. Huth. Breasted Ancient History Series. 16 maps. Denoyer-Geppert Co., Chicago, 1916–1920. Set, $26.70 to $79.40 according to mounting; single maps, $2.40 to $5.80. 32 x 44 inches.

S. B. Harding. Harding European History Series. 28 maps. Denoyer-Geppert Co., Chicago, 1916–1922. Set, $42.90 to $133.70 according to mounting; single maps, $2.40 to $5.80. 32 x 44 inches.

A. B. Hart (assisted by D. M. Matteson) and H. E. Bolton. Hart-Bolton American History Series. 24 maps. Denoyer-Geppert Co., Chicago, 1918–1921. Set, $37.50 to $115.60 according to mounting; single maps, $2.40 to $5.80. 32 x 44 inches.

Hutton Webster, D. C. Knowlton, and C. D. Hazen. Ancient History Maps. 18 maps. A. J. Nystrom and Co., Chicago, [1922–1923]. Set, $36.75 to $68.50 according to mounting; single maps, $3.00 to $7.00. 38 x 50 inches.

Hutton Webster, D. C. Knowlton, and C. D. Hazen. Medieval and Modern History Maps. 26 maps. A. J. Nystrom and Co., Chicago, [1920–1921]. Set, $47.50 to $94.50 according to mounting; single maps, $3.00 to $7.00. 38 x 50 inches.

W. L. Westermann. Westermann Classical and Historical Maps. 12 maps. Rand, McNally, and Co., Chicago, [1922]. Set, $158.00 to $173.00 according to mounting; single maps, $8.75 to $14.25. 46 x 66 inches.

C. R. Dryer, W. M. Davis, the late S. W. Cushing, Ellsworth Huntington, J. W. Redway, Frank Carney, W. S. Tower, J. Russell Smith, G. B. Roorbach, edits. Denoyer-Geppert Political Geography Series. Two series: smaller-scale, 10 maps; larger-scale, 7 maps. Denoyer-Geppert Co., Chicago, 1919–1922. Smaller-scale series: set, $50.95 to $73.50 according to mounting; single maps, $3.40 to $6.80. Larger-scale series: single maps, $8.75 to $16.40 according to mounting. 58 x 44 and 78 x 64 inches.

V. C. Finch. Commercial Geography of the United States Series. 10 maps. A. J. Nystrom and Co., Chicago, 1919. Set, $20.00 to $57.50 according to mounting; single maps, $2.25 to $6.75. 38 x 50 inches.

[1] See *Bull. Amer. Geogr. Soc.*, Vol. 43, 1911, pp. 799–800.

[2] *Bull. Amer. Geogr. Soc.*, Vol. 46, 1914, pp. 715–717, and *Geogr. Rev.*, Vol. 5, 1918, pp. 87–88.

purpose of the publishers has been to meet American conditions; according to the respective sense of indebtedness of the authors and publishers credit is given, or withheld, to such authorities as Kiepert, Spruner, Poole, Schrader, Droysen. In the field of American history there have been no foreign models to follow, and it is therefore in this field that a distinctive contribution is made—just as in the case of Professor W. R. Shepherd's excellent "Historical Atlas" (New York, 1911), which is an adaptation of Putzger's well-known "Historischer Schul-Atlas" with the addition of original sheets on American history.

Earlier American History Series

The present Hart-Bolton series is not the first American wall map series dealing with American history. At least three have preceded it: those by Townsend Mac Coun (26 maps, Silver, Burdett & Co., 1889), by E. G. Foster (41 maps, Rand, McNally & Co., Chicago, 1900–1906), and by A. H. Sanford (33 maps, A. J. Nystrom & Co., Chicago, 1914). Mac Coun's series is a very worthy publication, revealing a knowledge of the sources as well as its author's geographical sense. In the latter quality the Foster series is signally deficient, the most elementary geographical features on some of its maps not being shown even in correct geometrical outline. In certain aspects of map technique, such as the representation of relief, the Sanford series is weak, mountains generally being shown in an ultra-primitive form of "caterpillar" ridges. In the treatment of the historical subject matter this series, however, belongs to the progressive modern school. The Hart-Bolton series bears a certain "family resemblance" to it, which is probably due to the fact that the geographical editor of that series was formerly associated with the firm that publishes the Sanford series.

American History Series

But it is only with the Hart-Bolton series that a complete interplay between geographical and historical methods is attained. There is a fullness of sweep about this series which betokens a real knowledge of the subject and its geographical method of expression. The maps are constructed in proper wall-map style, the underlying bases (printed in blue) of coast line, drainage, and relief in hachures being drawn boldly. The size of the maps, 32 by 44 inches, is large enough for adequate wall-map treatment and yet small enough for easy handling. An ingenious device is used to represent the area of main importance in our earlier history, the eastern third of the country, whereby it is possible to put two maps on one sheet and thus save space. On the left side of the sheet is shown the United States east of the Mississippi; this is separated from the other map on the right by a diagonal line from upper right to lower left, thereby leaving the suitable space to represent on the same scale the Atlantic seaboard region from the Appalachian Plateau to the ocean.

The spirit of the series is illustrated by the fact that of the 24 maps two-thirds deal with such matters as exploration and colonization, military campaigns, and economic development in agriculture, industry, and transportation, limiting to one-third of the maps the conventional topics of territorial development and state politics. Exploration figures especially on the first four maps. Maps 1 and 2 are world maps showing respectively the world at the time of Columbus and world exploration to 1580. As a background to Columbus' first voyage Map 1 shows the outlines of the land according to Behaim's globe of 1492; it also shows the land and sea routes to Cathay. These two maps, as well as Maps 14 and 22 in the European history series, are on a new projection devised by the publishers, which outwardly resembles Eckert's projections[3] and Winkel's recent projections.[4] Map 3 shows the principal routes of exploration in the Caribbean, 1492–1519. Map 4, in addition to territorial development from 1580 to 1750, indicates the routes of the French explorers from Champlain to La Salle in the Great Lakes region and the Mississippi valley. In addition Map 4 shows, for about the year 1660, areas actually settled. This is an important geographical element; it is also portrayed on the two parts of Map 7 for the years 1700 and 1760. This representation is probably based on the valuable maps in Vols. 1, 2, and 3 of Channing's "History of the United States" and deals with a topic in which the assistant editor of the present series, Mr. D. M. Matteson, has already made a fruitful contribution (see the map in Vol. 6 of Avery's "History of the United States"). Map 7 is primarily a map of colonial commerce and industries and indicates, for the period up to 1774, sea routes, roads, the location of economic resources and industries, and the volume of trade. A suggestive inset shows the triangular trade routes in the Atlantic, as from England to the West Indies, New England, and return.

Map 10, likewise a two-part map of the eastern United States, entitled "Westward Movement, 1763–1803 and 1803–1829," shows, on a hypsometric background, the main and secondary roads and canals of the two periods depicted. For the later period a main road is shown leading from Hartford, Conn., to Erie, Pa., across the Hudson presumably at Newburgh and the Delaware presumably at Port Jervis, then over the Pocono Plateau, and finally due west just south of and parallel to the Pennsylvania-New York border. Contemporary authorities do not seem to justify this representation. John Melish's standard map of the United States of 1816 in 1:3,801,600 and the stock map of the United States in 1:8,000,000, bearing copyright date of 1839, in the 1844 edition of H. S. Tanner's "New Universal Atlas" both show a marked gap at the Susquehanna. Tanner's map of Pennsylvania in 1:1,500,000 published in this atlas and elsewhere confirms this gap. Roads seem to have existed along portions of this route, but they seem to have been local roads and not parts of a trunk highway.

[3] *Petermanns Mitt.*, Vol. 52, 1906, Pl. 8.
[4] *Ibid.*, Vol. 67, 1921, Pl. 24.

Tanner's maps indicate a main turnpike from Newburgh via Monticello, N. Y., Montrose, Pa., and Owego, N. Y., to Ithaca, the road here forking, one branch going to Buffalo via Canandaigua and Batavia, the other going to Erie, Pa., within New York State via Bath, Angelica, and Mayville. This route (of which the Montrose-Ithaca-Buffalo section is indicated as a secondary road on Map 10) would seem better to reflect the main artery of traffic in that region at that time than one leading across the deeply dissected Appalachian Plateau of northern Pennsylvania between the headwaters of the Allegheny and Susquehanna Rivers, which region is rough country, still sparsely settled and even to this day less supplied with through roads than almost any other district of Pennsylvania.

For the period 1829–1860 there is a map (No. 13) of the whole United States showing land and water routes—the railroads and canals that existed in the eastern third of the country and the trails that led across the western two-thirds, the two systems joining at St. Joseph, Mo. Of modern economic maps there are several. Map 19 shows the present lines of transportation and is especially valuable for its distinction between main and secondary railroads. Map 20 shows the distribution of coal, oil, and other mineral resources in the West and, in an inset, the location of oil pipe lines. This map, which is in five parts, suffers from its discontinuity. Map 21, a two-part map of the eastern United States, represents, besides the coal-producing areas, the industrial areas in general and, in the part devoted to the Atlantic seaboard region, the textile areas, in two shades of intensity of development, and the manufacturing cities, distinguishing, according to the main product, cotton, wool, silk, shoes, and clothing centers. An inset shows the distribution of blast furnaces and steel mills in Pennsylvania and the upper Ohio region. Finally, Map 22 is an agricultural map of the United States and shows the areas devoted to the cultivation of wheat, corn (each, two intensities), cotton, and alfalfa and to the raising of meat cattle and dairy cattle. A map (No. 27) has recently been added to the series, representing the population density of the United States according to the census of 1920, by counties in six grades of density.

Only two of the maps are exclusively war maps. Map 8, one of the two-part maps of the eastern United States, is devoted to the Revolutionary War. Military campaign routes are boldly shown, American in black, British in red. There is an inset showing the campaign from the Highlands of the Hudson to the lower Delaware in greater detail. Map 16, of the Civil War, on a background of state allegiance and relation to slavery, shows the raided areas. Another element of geographical interest, the gradual advance of the Federal military occupation of the South, shown by lines for successive years, is rather obscured by the areal elements of the map; indeed, this map is somewhat overburdened. The area under Confederate control on March 1, 1865, is also shown. Three insets are devoted respectively to the Virginia, Atlanta, and Vicksburg campaigns. The campaign routes in the War of 1812, the Mexican War, and the Spanish-American War are

shown on maps primarily devoted to other subjects. (American participation in the World War is shown on Map 26 of the European history series.)

From this survey it will be seen to what extent maps of geographical interest predominate. A text manual for teachers accompanies the series. Although on each map the consultant is referred to the manual for explanations it would be better not to leave too much to this medium. Because of the physical separation of map and text it is a good cartographic principle always to make a map self-contained. As to the explanation of symbols this principle should be categorical. In addition it is desirable that the explanation be given in a legend and not on the body of the map. This is clearer and helps show at a glance what topics are treated on the map. The present series violates the categorical principle in a few cases and the desirable principle in several, as on Map 13, where the symbol for Western trails is not shown in the legend. Another imperfection is that on this and other maps water and sea routes are shown in too thin a line, thereby failing to be as visible as comparable land routes on the same map. It will be easy, however, to remedy these slight defects. Besides the manual the publishers have also issued an atlas, made up of reductions from the large wall maps, lithographed in the same colors as the originals. Although the maps are not specially engraved as atlas maps and hence sometimes suffer from the great reduction, the atlas is a most useful publication. Of each of the other two series issued by the same publishers there is likewise a manual and an atlas.

Ancient History Series

Of the five ancient and European history series less need be said, as they are less distinctive. That by Professor Breasted is, for ancient history, the most complete. To say that it reflects the spirit of his "Ancient Times" and other textbooks is to say that it has much geographical bearing. Such conceptions as his "fertile crescent" of Syria and Mesopotamia here again find representation. The accompanying manual, written mainly by Professor Huth, is exceptionally good and is one of those that, laudably, refers to the sources. Of the Webster-Knowlton-Hazen series, which nominally contains 18 maps, the last four deal with periods that are not usually included in ancient history, although they are probably so grouped to satisfy the prevalent courses in "early European history." Among the latter is a valuable map (No. 17) showing the expansion of Islam from 622 to 750 A. D. Of maps of geographical bearing among those dealing strictly with antiquity may be mentioned Map No. 1, which shows the trade routes and commercial products of the ancient world, and No. 2, which shows the geographical conception of the world held by the ancients, according to Homer, Herodotus, Eratosthenes, and Ptolemy—a topic dealt with in insets in one of the maps of the Breasted series. Of the 12 maps of the Westermann series the first six deal with ancient history—mainly territorial develop-

ment. There is a tendency in this series to relegate to insets topics that might deserve representation on main maps.

European History Series

In the field of European history Map 8 of the Westermann series is of special merit. It shows, as do the similar maps in the Harding (No. 8) and Webster-Knowlton-Hazen (No. 4) series, medieval commerce and its trade routes. As do these, it shows in the Mediterranean the trade routes of Venice, Genoa, and Pisa, but it distinguishes them by color and in addition it shows, colored to correspond, the land areas chiefly tributary to the trade of these three city states—an interesting geographical element. Of the two other series dealing with European history—the Harding series with 28 maps and the Webster-Knowlton-Hazen series with 26 (or 30 maps, if the last four of the ancient history set be included)—only those maps can be enumerated that are of geographic interest: Mongol-Turkish invasions, with Eastern trade routes (WKH 5); age of discovery (WKH 6, unfortunately on Mercator's projection, and H 14, on the same projection as, and similar to, Map 2 in the Hart-Bolton series); the territories of the colonial powers in 1783 (WKH 11, likewise unfortunately on Mercator's projection; for a correct equal-area representation of the identical topic see Pl. 8 of A. Supan's "Territoriale Entwickelung der europäischen Kolonien," Gotha, 1906); population density of England before and after the industrial revolution, about 1700 and 1900 (H 18 and WKH 24; practically identical pairs of maps, both based on a metric density unit, as reflected by such densities as "128–256 per square mile," or, in other words, 50–100 per square kilometer); present population density of Italy and Germany (H 19 and H 20); present economic status of Europe (H 24 and land utilization and industrial maps on WKH 25, the other two constituting this sheet representing the relief and population density of Europe); nationalities of Europe (H 25 and WKH 26; on the latter the Czechs incorrectly shown as extending beyond the Erzgebirge and Riesengebirge into parts of Saxony and Silesia); exploration and colonization of Africa (WKH 22). Both series have maps dealing with the World War (WKH 16 shows all the fronts in Europe and the Near East, with the western front enlarged in an inset; H 26 shows only the western front).

With regard to one of these maps (H 14), however, a point should be raised. Among the land routes shown on it is one leading from Bokhara to Peking first east-northeastwards along the northern foot of the Tian Shan, then presumably through the Dzungarian Gate and along the northern mountain-rimmed edge of the Gobi Desert, then down the Kerulen-Argun Rivers to the Amur where it leaves the great plateau of Central Asia, whence the route turns abruptly to the south-southwest along the foot of the Khingan scarp until it reaches Peking. It would be of interest to know on what source this delineation is based. The fundamental researches of Albert

Hermann on the silk trade routes seem to contain no reference to it; and, while individual portions of it may be valid, it hardly seems likely that a route should have made so great a detour, especially when the much more direct one along the southern border of the Tarim Basin, which is also shown and which was followed by Marco Polo, was in existence.

Political Geography Series

The Denoyer-Geppert political geography series is a creditable set of maps of the conventional type, i. e. with areal political coloring, either by countries or subdivisions of countries, the outstanding feature. Each of the continents except Australia is the subject of a map; likewise the World, the Eastern and the Western Hemispheres, the United States, and the Eastern United States. The maps are published in two sizes; in the larger size, 78 x 64 inches, the scales are unusually large for wall maps, as, for example, 1:3,168,000 for the United States and Europe (incorrectly stated on the map of Europe as "50 miles to the inch—approximately 1:4,500,000").

Two maps in the series (designated J9 and S9a) stand out as distinctive, each representing the world on a projection that is extolled as showing "the minimum of distortion in area [*sic*] and shape." This is a new projection, likewise devised by the publishers, which is similar to the previously mentioned one used on Maps 1 and 2 of the Hart-Bolton series and Maps 14 and 22 of the Harding series. Both projections are oval in outline and have straight parallels and curved meridians; the poles, however, instead of being points are expanded to half the length of the equator in the history maps and one-third its length in the political geography maps. In the former the distance between parallels increases slightly poleward, while in the latter it is constant throughout. The resulting image is very favorable, with compression of the land masses toward the poles relieved, to a greater extent in the historical, to a lesser in the political maps. As the two projections are compromises, they of course do not retain any one of the three main attributes of mathematically developed nets; particularly they are not equal-area projections. One of the two maps under consideration (S9a) shows the world only once, on a scale of 1:25,000,000; the other (J9) shows the world five times in four different projections, twice in the new projection in 1:38,000,000 and once each in Mollweide's, Gall's "stereographic," and Mercator's. This map therefore affords an excellent means of comparing the various current projections one with another and of estimating their respective advantages and disadvantages. The publishers and the editor deserve praise for introducing this valuable tool to teachers in this country. Besides exhibiting various projections each constituent map represents a different element. The main map on the new projection, with the Greenwich meridian in the center, shows political divisions; the other map on the new projection, with 90° W. as the central meridian—thus preserving the continuity of the oceans—represents world commerce, the

volume of sea-borne traffic being shown by steamship route lines of proportional thickness. The Mollweide map shows drainage basins, the Gall map the peoples of the world, and the Mercator map the principal telegraphs and cables.

The map of the eastern United States in 1:2,500,000 is likewise an innovation. It is the first wall map of a part of the United States to appear; and it is to be hoped that it may be followed by other sectional maps of our country, preferably physical maps showing relief. This would be a distinctive contribution and open up a field that has not yet been touched.

United States Economic Geography Series

Finch's economic geography map series of the United States is a contribution of this nature. It consists of a set of plates the majority of which each contain four maps of the United States in about 1:8,000,000. The maps show the distribution of the following products and industries: Pl. 4: winter and spring wheat, oats, corn, barley and rice; Pl. 5: beet and cane sugar, apples and citrus fruits, tobacco, cotton and flax; Pl. 6: vegetables, potatoes, hay and forage, horses and mules; Pl. 7: cattle, dairy products, sheep, swine; Pl. 8: coal, petroleum and natural gas, iron ore, copper, silver, and gold; Pl. 9: manufacturing industries, meat packing and fishing, flour and grist mills, leather manufacture; Pl. 10, iron and steel industries, lumber industries, cotton manufacturing, wool, silk, and linen industries. These distributions are shown by the "dot" method made familiar in Finch and Baker's economic atlas entitled "Geography of the World's Agriculture"[1]; indeed the agricultural maps in the present series are wall-map adaptations of the corresponding maps in that atlas. The industrial maps, however, have not been published before. The dot method is a most felicitous solution of the problem of portraying statistical material areally. Each dot represents a definite unit value, so that by counting the dots one can determine the total amount within a given area of the product represented; nevertheless, when viewed as a whole, the dots have a mass effect which provides an excellent generalized picture. Under each map are graphs showing the total production of the given staple in the states of the United States and the countries of the world which lead in that staple. The map of the United States used as a base for these economic data shows relief in a rather ineffective gray shading. However desirable it may ordinarily be to show relief as a background, in this case it is unfortunate, as the gray is often deeper in tone than the tint used in addition to the dots in the case of agricultural products to show the principal productive areas. When this tint is pale green, as in the case of Map 4a (wheat), the gray drowns the green.

The economic maps are preceded by three plates. Plate 3 contains four maps of the United States, each likewise in 1:8,000,000, showing respectively: average winter and average summer rainfall and average January

[1] See *Geogr. Rev.*, Vol. 9, 1920, pp. 74–76.

and average July temperatures, with prevailing wind directions. Each pair of maps is accompanied by a set of graphs representing the average monthly amount of the given climatic element at selected stations across the country. On these maps the representation of relief is eminently desirable, and, because of the type of symbols used, it does not clash with them. Plates 1 and 2 are valuable large maps of the United States (scale 1:4,000,000). Plate 2, dealing with land utilization, shows grazing land, desert land, and irrigated land areally and agricultural land by the dot method, each dot representing 20,000 acres. Plate 1 shows population density by green dots, each representing 5000 people, and the main railroad lines in red. This method of representing population density, as compared with the usual areal one, brings out clearly the concentration around urban nuclei.

Conclusion

Inasmuch as the maps that have here been reviewed or mentioned represent numerically the great majority of all modern wall maps published in the United States it may in conclusion not be out of place to enumerate the few others that complete the list. These are, so far as known, Chamberlin's map of North America during the Great Ice Age (1913), Van Cleef's rainfall map of the United States[6], Nystrom's rainfall map of the United States based on Gannett[7], Harshberger's vegetation map of the United States[8], and Jastrow's linguistic map of Europe and the Near East (1919?). Lobeck's admirable physiographic block-diagram map of the United States, although not strictly a wall map, may also be mentioned here; attention has already been called to the method of representation employed.[9] The large productivity which the aggregate of these maps betokens and particularly the high quality of those most recently published show that we have definitely entered the path of emancipation from the slavish copying of European models and are on the way to developing distinctive wall maps suited to our own needs.

[6] Reviewed in *Geogr. Rev.*, Vol. 7, 1919, pp. 269–270.
[7] On this source see Mark Jefferson, *Geogr. Rev.*, Vol. 1, 1916, p. 203, note 1.
[8] *Geogr. Rev.*, Vol. 10, 1920, p. 54.
[9] *Geogr. Rev.*, Vol. 13, 1923, pp. 322–323.

AMERICAN GEOGRAPHICAL SOCIETY

Meetings of March and April and Elections to Fellowship. Regular monthly meetings of the Society were held on March 25 and April 22 respectively, at the Engineering Societies' Building, 29 West Thirty-ninth Street. At the March meeting Mr. Poultney Bigelow addressed the Society on "The Colonies of Japan." The April meeting was the occasion of the presentation of the Charles P. Daly Medal to Colonel Claude H. Birdseye. After the ceremony (described below) Colonel Birdseye spoke of the work of his recent expedition (see the article "A Boat Voyage Through the Grand Canyon of the Colorado," in the April number of the *Geographical Review*) in an address entitled "Boating in the Grand Canyon."

At the March and April meetings, President Greenough presiding, there were presented with the approval of the Council the names of 50 candidates who were duly elected as Fellows.

Presentation of the Charles P. Daly Medal to Colonel Claude H. Birdseye. The Charles P. Daly Medal of the American Geographical Society was presented to Colonel Claude H. Birdseye at the April meeting of the Society. In presenting the medal President Greenough spoke as follows:

"In contrast with the changes in national politics from time to time is the work of the various permanent bureaus of the government in Washington. These afford satisfaction and pride to the patriotic observer by reason of their effective and useful work and by the high attainments and unostentatious devotion of many of the individuals who comprise their staff. Amongst these the U. S. Geological Survey is justly esteemed as embracing a personnel whose scientific reputation and authority are universally recognized. Upon it devolves the duty not only of determining the topography and characteristics of the national domain, but of following similar development in foreign lands. In this country its investigations are directed with an eye to the practical advantage of the people, as well as to scientific relations and adaptations.

"Colonel Claude H. Birdseye, Chief Topographic Engineer of the Survey, is our guest tonight to receive your gold medal. By his achievements and writings he has gained eminence in both divisions of the government service, and in according him your memorial you are giving recognition to the permanent benefits which he has bestowed upon his country. This medal is awarded by the terms of its foundation for exploration or for additions to geographical knowledge and has been given in the past to explorers Amundsen, Stefansson, Younghusband, to scientists Penck, Vidal de la Blache, Chisholm, Thoroddsen from other countries, and to our own citizens Peary, Greely, Leffingwell, Chaillé-Long, Davidson, Rockhill, Brooks, Gilbert, George Otis Smith. The present recipient is a worthy companion of the notable names I have mentioned, and it may add to our satisfaction that another of our countrymen is by its bestowal joined in fellowship with our friends of foreign birth. His military services in the Great War advanced him to high rank and added to his distinctions gained in civil life. He has published various valuable works, amongst which may be mentioned: "Manual for the Artillery Orientation Officer," "Meridian Determination," "Circumpolar Ephemeris," "Triangulation and Primary Traverse, 1916–1918." It is chiefly upon the foregoing record that the present award is made. That his occupation is also not without adventure is evidenced by his latest expedition, made last year through the Canyon of the Colorado for the purpose of a detailed survey and profile of the river

and the determination of its possibilities for the development of power and of irrigation. This dangerous and useful undertaking was successfully completed, and he will favor us with some descriptions and pictures indicating the character and episodes of the journey.

"And now, Sir, I beg that you will receive from me, on behalf of the American Geographical Society, this token of their appreciation of your valued contributions to science and at the same time of their personal admiration and regard."

In accepting the medal Colonel Birdseye modestly disclaimed any credit for the medal presented to him preferring that his associates share the honor of the award. He referred briefly to the work of colleagues and friends in the field of topographic mapping and exploration and particularly to the exploits of Frederick S. Dellenbaugh and Emery C. Kolb both of whom have made the descent of the Grand Canyon, the former as a member of Powell's expedition and the latter on a private venture with his brother Ellsworth Kolb in 1911 and again as chief boatman for Colonel Birdseye's expedition of 1923.

Award of the Cullum Geographical Medal to Jovan Cvijić. The American Geographical Society announces the award of the Cullum Geographical Medal to Professor Jovan Cvijić of the University of Belgrade. The medal bears the inscription:

Jovan Cvijić
1924
For the scholarship displayed
in his published works
on the geography of the Balkan countries
and for the originality of his field studies
on the complicated physiography
of the Karst

Professor Cvijić's substantial and original studies are well known to all students of Balkan geography. They are incorporated in part in his important monograph "La Peninsule Balkanique" (1918). In the *Geographical Review* his work is represented by the articles "The Geographical Distribution of the Balkan Peoples" (Vol. 5, 1918), "The Zones of Civilization of the Balkan Peninsula" (Vol. 5, 1918), and "The Evolution of Lapiés: A Study in Karst Physiography" (January, 1924). The last-named treats of one aspect of karst erosion—a subject in which Professor Cvijić has done definitive work.

Award of the David Livingstone Centenary Medal to Frank Wild. Announcement is made of the award of the David Livingstone Centenary Medal for 1924 to Frank Wild. This medal, founded by the Hispanic Society of America and awarded by the American Geographical Society, is given "for scientific achievement in the field of geography in the southern hemisphere." Commander Wild has had an important share in recent Antarctic expeditions. He was with Scott on his first expedition, 1901–1904; with Shackleton, 1907–1909; with Mawson, 1911–1914, on the last-named acting as leader of the western party (see Sir Douglas Mawson: "The Home of the Blizzard," Vol. 2, pp. 50–107). He was second in command on Shackleton's expedition of 1914–1917. On this occasion he was in charge of the Elephant Island party whose rescue has furnished one of the notable events in the annals of polar exploration (see *Geogr. Rev.*, Vol. 2, 1916, pp. 54–57 and 231–232). Wild was again chosen as his second in command by Shackleton on his last expedition, the voyage of the *Quest*, and assumed command on the death of the leader at South Georgia. Commander Wild has related the history of the expedition in his book "Shackleton's Last Voyage" (noted in this number of the *Geographical Review*, pp. 484–485).

Election of Corresponding Members. The Society further announces the election of Dr. Edwin R. Heath, Dr. H. L. Shantz, and M. Paul Le Cointe as Corresponding Members.

DR. HEATH, now of Kansas City, Mo., is well known for his geographical work in South America. He explored the Rio Beni region from 1879 to 1881, making both descent and ascent of the main river. It was in recognition of his achievement that a branch of the Rio Beni north of Lake Titicaca was named Rio Heath. The first statement of his explorations is given in the *Journal of the American Geographical Society* for 1882.

DR. SHANTZ, of the Department of Agriculture, Washington, D. C., has traveled extensively in Africa as agricultural explorer, crossing the continent from Cape Town to Cairo. He is now engaged in further study in plant ecology in this field. He is the author of "Urundi, Territory and People" in the *Geographical Review* (Vol. 12, 1922) and is joint author with Dr. C. F. Marbut of "The Vegetation and Soils of Africa" (with colored maps), *Research Series No. 13*, published by the American Geographical Society in co-operation with the National Research Council.

M. LE COINTE, of Belem (Pará), Brazil, is the author of "L'Amazonie brésilienne: Le pays—ses habitants, ses ressources, notes et statistiques jusqu'en 1920," a scientifically executed work of encyclopedic proportions and character based on a long residence in the country (see the *Geogr. Rev.*, Vol. 13, 1923, pp. 634–636).

RECENT PUBLICATIONS

The Geographical Conceptions of Columbus: A Critical Consideration of Four Problems. Under this title the Society is about to publish No. 14 of its *Research Series*, by Dr. George E. Nunn. At first thought it would seem as if little that is new could be presented regarding Columbus and his great enterprise, both because of the amount of what has been written on this subject and because of the newer critical researches associated with the names of Vignaud, Harrisse, and others. But the topic has so many aspects, and even the primary sources such as Columbus' own writings and the contemporary records leave so many gaps in our knowledge, that these investigators have not been able to exhaust the subject. There still are individual problems to be solved and already established conclusions to be reconsidered and possibly modified. It is with four such problems that Dr. Nunn's book deals.

The first study is entitled "The Determination of the Length of a Terrestrial Degree by Columbus." It shows that there is no reason to doubt, as do Vignaud and other critics, Columbus' statement that he had verified the value current at the time by determining it himself. The criticism is based on the assumption that a measurement of a particular degree by instruments of precision is meant. That, the author concedes, was impossible. He shows, however, that Columbus utilized existing values for the latitude of Lisbon and the Upper Guinea coast and divided the distance between them as determined by him on his voyages to Africa by the difference of latitude. Through a curious set of coincident inaccuracies the result confirmed the then accepted value of 56⅔ miles to a degree. Columbus' interest in determining the length of a degree lay in his desire to evaluate the distance in miles between the western coast of Europe and the eastern coast of Asia by means of the current estimates of this distance expressed in degrees. On the undervaluation that he derived from this calculation the theory of his first voyage was in great measured based, and this incorrect conception dominated his thought to the end.

In the second study, entitled "The Route of Columbus Across the Atlantic and Return on His First Voyage," the author shows that Columbus carefully selected his route on the basis of his knowledge of the winds and currents as observed on

the outpost islands of the Azores, Madeira, and the Canaries. On his outward voyage he first went south to start from the Canaries and thus to be able to utilize the westward current and the northeast trade winds of that latitude. On his return he went far to the north to avoid these and then turned east when in the latitude of the Azores to utilize the eastward current and the westerly winds of this belt.

The question of the third study, "Did Columbus Believe That He Reached Asia on His Fourth Voyage?", the author answers in the affirmative. Believing that Cuba was that projecting part of the mainland of Asia called on the contemporary maps Mangi, Columbus, in going southwest from Cuba and skirting the coast of the present Honduras and Nicaragua towards the south, believed that he was cutting across the gulf in the China Sea enclosed by Mangi and Ciamba, the next region to the south, and that he was following the Asiatic coast southward toward the Strait of Malacca, whence he at one time considered returning to Spain by way of the Indian Ocean. Even the eastward trend of the coast of Panama did not disillusion him because this fitted a description by Marco Polo. Nor does the fact that he himself called a part of his earlier discoveries Mondo Novo prove, as some critics have asserted, that he knew he had found a new world and not the east coast of Asia. The author shows that by Mondo Novo he designated the part of South America that he had discovered on his third voyage, the continental nature of which land he recognized. But this was not incompatible with believing Cuba and Central America a part of Asia. Indeed, his conception is probably correctly illustrated by the sketch maps drawn by his brother Bârtholomew, which were brought to light by von Wieser, on which Asia and the Mondo Novo are connected through Panama.

The fourth study, entitled " 'Florida' on the Cantino Map of 1502," explains the *raison d'être* of the land area occupying the relative position of Florida or the mainland of the United States on the western edge of this important map. On it there are many names along the coast of "Florida," while there are no names on the coasts of the island representing Cuba. By a critical comparison of the names on the "Florida" coast with those given by Columbus to the coastal features of Cuba (conceived as part of Asia) on his first and second voyages and with those derived from the Corte-Real voyages, the author demonstrates that "Florida" is part of the mainland of Asia. That the eastern coast of Asia is also represented on the eastern edge of the Cantino map does not invalidate this conclusion—the map in this reflects the conflicting schools of geographical thought of Ptolemy and Marinus of Tyre.

The book is furnished with text illustrations reproducing in facsimile the portions of medieval maps that concern the discussion and with two separate original colored maps by the author representing (1) the route of Columbus on his first voyage across the Atlantic and return to show his utilization of the winds and currents and (2) the route of the fourth voyage as Columbus conceived it to be along the coast of Asia and as it actually was along the coast of Central America.

Geography in France. The publication of "Geography in France," by Emmanuel de Martonne, *Research Series No. 4a*, is announced. This continues the line of investigation carried out in "Recent Geographical Work in Europe" by W. L. G. Joerg, *Geographical Review*, Vol. 12, 1922, pp. 431–484 and "The Position of Geography in British Universities" by Sir John Scott Keltie, *American Geographical Society Research Series No. 4*, 1921.

The aim of Professor de Martonne's work is stated thus: "To acquaint the reader with the status of geographical activities in France under all their aspects by tracing the origins of those tendencies whose effects we are at present experi-

encing, by explaining the distinctive characteristics of the French geographical schools, and by giving all the practical indications which are necessary to orient oneself in the mass of publications and to keep abreast of the developments of our science." The titles of chapters indicate the scope of the work: General Characterization, Geographical Societies and Kindred Institutions, Geography in the Universities, Geography at the University of Paris, Geography in the Provincial Universities, Government Departments Contributing to Geography, The Leading Geographical Journals and Series, Conclusion. The data relate to 1923.

By reason of its philosophical treatment the book is valuable also as a contribution to the history of science.

Co-operation of the American Geographical Society in the Preparation and Publication of the "Bibliographie Géographique." The Society is pleased to announce the completion of an arrangement between itself and the Association de Géographes Français for the participation of the Society in the publication of the well known *Bibliographie Géographique*, until recently an annual supplement to the *Annales de Géographie* (see note in *Geogr. Rev.*, Vol. 13, 1923, p. 480). The Society has felt for some time that there should be participation on a co-operative basis in order to make available in this country a well rounded geographical bibliography to supplement the reviews and records now published in the *Geographical Review*. It seemed that the best means at hand to put this plan into effect was to co-operate with the editor and collaborators of the *Bibliographie Géographique*, contributing to it through the Society's library a part of the material, especially that relating to works published in the Western Hemisphere. By the terms of the agreement between the French and American organizations concerned the Society will distribute the volume in the United States and Canada, and this it will do at the price at which the volume is sold at Paris (about one dollar U. S. gold). It will be distributed free to those Fellows of the Society who request it. It is hoped that in this way the Society will be able to make a substantial contribution to the facilities for research in this country, especially among professional geographers in our schools and universities, where the need for fuller bibliographical equipment has been felt. The first number of the *Bibliographie Géographique* to contain material contributed by the Society will be the volume dealing with publications of 1923, now in preparation.

GEOGRAPHICAL RECORD

NORTH AMERICA

The Oceanic Spring off St. Augustine, Fla. Is it a coincidence that numerous sulphur springs are found near the very place of the landing in America of Ponce de Leon in his search for the fabled Fountain of Youth, or did the legend originate from the fact of the existence of these springs? The "Fountain of Youth," a spring in the city of St. Augustine, recorded as a landmark in an old Spanish grant, is still preserved as one of the numerous and varied attractions for visitors.

Most interesting geographically, however, is the curious natural phenomenon of an oceanic spring off the coast. It bubbles up with marked surface disturbance through fifty feet of water from the ocean bed; in fact were the outlet of this spring on shore, it would probably resemble a geyser rather than a spring. The existence of this spring, nine miles southeast of the city of St. Augustine, has been known for a number of years; and its position has been shown on charts of the locality as in latitude 29° 46′ 05″ N. and longitude 81° 12′ 29″ W., about two and one-quarter miles off the coast.

In connection with a hydrographic survey of the east coast of Florida in 1923, a special investigation of the spring was made by Lieutenant A. M. Sobieralski of the U. S. Coast and Geodetic Survey. The investigation consisted of a hydrographic development of the vicinity, together with the collection of surface and bottom samples of the water, and surface and bottom temperature observations. Lieutenant Sobieralski's report gives the following description. "The location of the spring may easily be detected by the appearance of the water; noticeable swirls, similar to those in a swiftly running stream, can be seen at a distance of about a mile. At times, especially in rough weather, there is a marked disturbance of the water—a yellowish color which trails off to the northeastward. In choppy weather, a 'slick' is the most noticeable feature. In fact, it has all the appearance of a shoal or reef.

"A closer view shows a slick swirl with a slight overfall, the center of the swirl moving about 100 feet, first to the eastward and then to the westward, and a noticeable streak of current to the northeastward. The swirls and overfalls vary rapidly in intensity, as though large bubbles or intermittent volumes of water were being emitted. A boat will be thrown out of the swirl so that it is difficult to hold it in position.

"A strong odor, quite similar to the smell of water from the various sulphur springs of Florida, is noticeable, and under favorable circumstances can easily be detected two miles away."

The water is described as unpalatable and decidedly brackish in taste. The density is not greatly different from that of the ocean water in the locality. The temperature observations indicated no noticeable differences in temperature, either on the surface of the spring or at the bottom, from the temperature of the surrounding ocean water. And the surrounding ocean water has little difference in temperature between the surface and bottom at the depth found in the vicinity of the spring. The ocean floor in the vicinity is thus described: "The ocean bed in the vicinity of the spring is comparatively level and about 55 feet deep, composed of fine gray sand. The spring emerges from a hole only about 25 feet in diameter and 125 feet deep, or 69 feet below the surrounding ocean bed. This peculiar formation . . . is the most remarkable feature of the spring and gives an indication of the enormous volume of water which must be emitted, for otherwise the fine sand

composing the ocean bed would soon level off the hole. To the northeast of the center of the spring, the hole is enlarged to a diameter of about 300 feet; this shape of the enlarged hole probably directs the current from the spring in the northeasterly direction noted on the surface."

G. T. RUDE

Land Hunger and the War of 1812. An hypothesis of geographical interest is advanced by Mr. Louis Morton Hacker in explanation of the part played by the West in the War of 1812 (Western Land Hunger and the War of 1812: A Conjecture, *Mississippi Valley Hist. Rev.*, Vol. 10, 1924, pp. 365–395, Cedar Rapids, Ia.). "Ships, seamen, and cargos" were of little concern to the frontiersman. The reasons usually advanced—vindication of the national honor, riddance of an unfriendly power to the north, removal of the Indian threat—are not entirely convincing. In the frontiersman's slogan "On to Canada" Mr. Hacker finds an expression of territorial desire.

In the first decade of the last century the frontier was roughly defined by the edges of a wedge thrust into the continent with its apex at the confluence of the Mississippi and Ohio Rivers, though isolated communities had transgressed beyond these confines. The census of 1810 showed about a million settlers in the Ohio valley. For the most part they were engaged in the expansive and wasteful husbandry that characterizes a pioneer society. Large areas of virgin soil were needed: the frontier settler was continually on the move, "it was his wasting land that drove him on. Hunger was the goad." The settlers of the Ohio valley faced a great country beyond the Mississippi, but the prairies had little attraction for them. "The prairies," believed the pioneer and the farmer of the Ohio valley, "could not be tilled because they were so far removed from the centers of communication, the rivers; because they did not furnish an adequate water supply for drinking and for the erection of mill seats; because they were unhealthful; and because they were bare of that natural element so important in the life of the farmer of the early nineteenth century—timber."

On the other hand the occupants of the Ohio valley looked to the St. Lawrence with rich bottom lands still untouched by the plow. Contemporary accounts furnish glowing pictures. "One may well imagine the hope that such a passage as the following aroused: 'The country around Lake Ontario is almost everywheres extremely fertile, particularly that part which lies at the western end and on the Niagra River. Perhaps this is excelled by no part of the world. . . . The soil along Lake Erie is excellent and that of Huron and Superior is understood to be generally good. Perhaps no country on the globe could furnish such inexhaustible stores of ship timber as that which surrounds Lake Erie and Ontario.' To the farmer this meant easy transportation, mill seats, abundant harvests, and fuel, fences, and farm buildings. If the United States was to have room for expansion, the proper direction for its energies was to the north."

EUROPE

Geography and Proposed Territorial Reorganization in Italy. "For various reasons, during the last few years, the problem of the division of Italy into regions has greatly stirred the public. Since the World War, regionalistic tendencies, which had seemed dead or dormant, have here and there come to life again, and one political party supports a program of regional autonomy." With these words Professor Olinto Marinelli begins an important monograph that appeared in two recent numbers of *L'Universo* ("La divisione dell' Italia in regioni e provincie con particolare reguardo alle Venezie," Vol. 4, 1923, pp. 839–858, 915–954). A larger

territorial unit than the present province is generally deemed necessary if urgently desired improvements in the administration of justice, of education, of the army, etc., are to be effected. It is also needed in connection with electoral reforms.

The map shows that Italy is split into sixteen major divisions: Piedmont, Liguria, Lombardy, Venetia, Emilia, Tuscany, Marches, Umbria, Rome, Abruzzi and Molise, Campania, Apulia, Basilicata, Calabria, Sicily, and Sardinia. These major divisions—until 1911 called *compartimenti* in the *Annuario Statistico*, since then called *regioni*—have no legal or administrative status and are officially recognized as statistical units only. There are several serious objections to the apparently simple procedure of directly converting the old *compartimenti* into administrative divisions. Marinelli summarizes these objections thus: "Not to mention the defects of the provincial circumscriptions which they bring together, the *compartimenti* have their own defects: either because in their composition more regard was had for history than for geography or because they are not all fortunate in their names or because of their overwhelming inequality in area and population or finally because they take no account of the economic, demographic, and social developments of the last sixty years."

The problems, therefore, present themselves of forming wholly new administrative circumscriptions and of reorganizing the provinces, on the effective grouping of which the new circumscriptions must inevitably be based. Professor Marinelli believes that the geographer can give valuable advice leading toward the solution of these problems by "marking out the natural areas within the limits of which civil and economic history have progressed each in its own way in the past or may so progress in the future; regions to which it will be opportune as far as possible to adapt administrative circumscriptions." He shows that the methods of detailed research developed by the leaders in the modern science of human geography can here be turned to markedly practical ends. His immediate purpose is to prepare the way for a thoroughgoing discussion of the entire subject at the Ninth Italian Geographical Congress at Genoa (April, 1924). This he undertakes to do, first by outlining certain principles and, secondly, by showing how these principles might be applied in dealing with a particular region—the so-called three Venetias. The monograph as a whole is a stimulating essay in what we may style "applied human geography."

Four fundamental principles are set forth by Marinelli, as follows: (1) each region should diverge as little as possible from a certain mean area; (2) it should diverge as little as possible from a certain mean population; (3) it should correspond, at least approximately, to an "historico-natural" or "economico-natural" region; and (4) it should possess an historic or economic center. The criteria for determining the limits of the natural, historic, or economic regions which are to serve as the bases for the anthropogeographic regions; the relative importance to be given to each of these three elements; the extent to which present provinces should be reorganized and new provinces created—these are matters of detail which can be solved for each region only after prolonged research into local conditions and history, research of a type suggested by the scholarly second part of Marinelli's paper.

The problem of administrative boundary drawing does not present difficulties of this character in a new nation like the United States, where territory, state, or county lines are marked out before the country is settled or during its formative period. On the whole, the delimitation of areas both large and small is a simple matter of geometry and surveying. In Italy, on the other hand, every new administrative boundary must represent a series of compromises between the demands of nature and economics on the one hand and, on the other, deeply ingrained traditions and customs that are the inheritance of more than two millenniums of civilized occupation of the land.

The American, brought up to accept the federal principle, will find certain passages and quotations in Marinelli's monography of particular interest. These reveal a profound distrust of federalism in the minds of many Italians, a distrust understandable in view of Italy's disunited past and the evils which disunion for so many centuries imposed upon her. Any movement toward local autonomy is apt to be looked upon as a movement of political retrogression. The new regions envisaged by Professor Marinelli are presumably intended to serve the ends of administrative convenience and efficiency alone.

Cotton Raising in Sicily. In the *Bollettino della Reale Società Geografica Italiana* (Series V, Vol. 12, 1923, pp. 492–512) Professor Sebastiano Crinò discusses the problem of cotton raising in Sicily. The enormous rise in the price of raw cotton since the World War has placed an intolerable burden upon Italian manufacturers, and it is hoped that relief may be afforded by the encouragement of cotton growing on Italian soil. Sicily, as distinguished from the African colonies, is extraordinarily well adapted by nature to this purpose. Backward methods of agriculture and the fear of taking risks, however, have prevented the people from making the most of their natural advantages, though the possibility of successful cotton raising on a large scale was impressively revealed during the American Civil War. An attempt is being made by demonstration and experiment fields to educate the people in more effective agricultural methods.

Cotton crops are now grown almost exclusively on a series of isolated alluvial plains along the southern coast and in small patches around the borders of the argillaceous plain of Catania. There is no question but that larger areas could be brought under cultivation with more modern methods. At present most of the raw cotton is shipped by rail to Naples, Genoa, Turin, and especially to Lombardy.

It has been shown, according to an authority cited by Professor Crinò, that the mean production of cotton per acre in Sicily is twice that of India or the United States. Under irrigation the production may be raised to very much higher figures. Indeed, Professor Crinò concludes that government encouragement in the construction of proposed mountain reservoirs is of first importance in the development of Sicilian agriculture, whether in cotton or in grains.

An Irrigation and Hydro-electric Project in Sardinia. The recent construction of a huge dam across the Tirso, the largest river in Sardinia, and the impounding of the waters into a great artificial lake foreshadow notable future economic progress in the island. Two geographical circumstances have contributed to keep Sardinia in a relatively backward condition. One of these has been the lack of coal resources, the other has been the climate: specifically, the uneven distribution of rainfall throughout the year.

A concrete example of the evil effect of the high cost of coal is the recent enforced suspension of tramway service in Cagliari. Sardinia is rich in other minerals, particularly zinc. Were coal readily available, prosperous metallurgical industries might have sprung into existence, but, as it is, the minerals of Sardinia have been exported in the raw state, and the benefits accruing from their manufacture have been reaped elsewhere. It is expected that the hydro-electric power generated by the water flowing from the new lake and by power stations to be built elsewhere will bring about an industrial era. Much confidence is placed in the development of the use of electricity in the metallurgical arts and particularly in its application to the manufacture of zinc products.

As in other parts of the Mediterranean zone, the uneven distribution of rainfall throughout the year has not only prevented the growth of local industries based upon water power but has exerted an extremely restrictive influence upon agri-

culture. Most of the rain comes in the winter and early spring. During the long, dry summers the streams dwindle away. When the freshets have passed, stagnant pools of water linger in the channels of the rivers breeding swarms of Anopheles, or malarial mosquito. Such a deadly scourge is malaria that, as in Sicily (see *Geogr. Rev.*, Vol. 14, 1924, pp. 144–145), much of the open country is abandoned altogether during the hot season. This disease and the constantly recurring droughts render agriculture precarious and unremunerative in large tracts of country of high potential fertility. Some of the largest of these tracts will be brought under irrigation by water derived from the Tirso lake, and the regulation of stream flow should go far toward eliminating the menace that lurks in the stagnant pools.

The project of the Tirso lake is described by Marcello Vinelli in *Le Vie d'Italia e dell' America Latina*, Vol. 30, 1924, pp. 201–210. Vinelli's claim that the Sardinian lake is the largest artificial lake in the world is entirely unfounded. This lake is 20 kilometers (12.4 miles) long by 2 kilometers (1.2 miles) wide in some places and has a capacity of 416 million cubic meters (109,854 million gallons). The Ashokan reservoir, which supplies New York City, is slightly larger; the Aswan reservoir in Egypt when full has more than twice the capacity; the lake impounded by the Roosevelt dam in Arizona has nearly four times the capacity; not to mention Gatun Lake in the Panama Canal Zone with a capacity of more than fourteen times that of the Tirso lake!

Military Tunnels in the Glaciers of the Ortler. Italian and Austrian operations in the Alps during the late war presented novel problems in military engineering. On the great Ortler massif alone some 36,400 feet of tunnels were excavated through ice at altitudes of over 9800 feet. Experience in their construction and maintenance during the war and their subsequent history have served to make clear several important matters regarding the nature and movements of glacial ice (see the discussion, with most interesting photographs, cartograms, and cross sections, by Guido Bertarelli: Le gallerie di guerra nei ghiacciai dell' Ortler, *Le Vie d'Italia*, Vol. 29, 1923, pp. 760–774).

Most of the tunnels encircled the heads of glaciers, keeping close to the steep walls of the cirques and ridges above and thus providing communication between positions which otherwise could not be reached without the danger of exposure to enemy observation or fire. The largest of the tunnels, however, was constructed by the Italians directly through the mid-course of the Glacier of the Zebrù not far above a point where the glacier plunges with a confusion of crevasses and *séracs* over an ice fall. This Galleria di Capanna Milano, while not the longest of the tunnels, was no less than 10 feet wide by 8 feet high. An Austrian tunnel was built to the highest summit of the Ortler (12,808 feet).

Several of the tunnels were excavated through relatively thin mantles of ice at high altitudes. Here it was observed that snow falling in winter seemed to be converted rapidly into ice despite the fact that there was no pressure from overlying masses of snow. The ice in some of these positions was found to be almost stationary. Even where it clung to precipitous slopes, the tunnels through it were unexpectedly permanent, and many of them were still intact as late as 1922. On the other hand, the congelation of snow accumulated from avalanches was relatively slow; and great difficulties were experienced in maintaining tunnels through such accumulations. The history of the Capanna Milano tunnel illustrates the law that the mid-course of a glacier moves more rapidly than its upper reaches and the center more rapidly than the margins. Furthermore, the central part of this tunnel "underwent a pressure from beneath upwards and a twisting from right to left." As a result, the walls, floor, and roof were squeezed together at a rate of about a meter every two or three months; and constant, arduous labor was necessary

to prevent the obliteration of the passageway. Since the war the tunnel has been completely destroyed, though traces of its former entrance were in evidence in 1922 far below in the ice fall.

It appears that glacial ice does not readily transmit sound. On one occasion the Austrians were able to construct a tunnel within 100 feet of an Italian position, without being detected, and thereby to launch a disastrous attack.

The Geographic Regions of Russia. The project of a complete and systematic description of Russia according to its geographic regions was launched in February, 1920, by the Commission for Study of the Natural Productive Forces. The project was suggested by the situation presented of political reunification accompanied by extreme economic disintegration, particularly in the realm of transport. A summary account of the work of the commission by G. P. Blok states: "The latter circumstance necessitated a transformation of the entire economic system, beginning with a large measure of decentralization; and, to this end, the first requirement was to arrange the partition of Russia into districts, each of which, resting on a definite economic foundation, would possess within itself the possibility of existence independent of the center of economic life." The commission proceeded to mark out such regions and undertook to make them the basis of a new general description of the country under the title "Rossia."

Up to date, its interest lies rather in the plan than in the actual work, of which only a few parts dealing with the Astrakhan country, prepared before the general design had taken shape, have been published. This plan differs from that followed in the standard compilation of Semenov and Lamanski chiefly in the principle of regional division adopted. In place of such designations as "Moscow and the Upper Volga" and "The Upper Dniepr and White Russia" we find "Central Industrial Province" and "Western Agricultural Province." Twenty-three volumes, each dealing with one such region, are planned for European and Asiatic Russia. The plan also provides for uniformity in treatment of the various topics considered under each region, with a general editor for all chapters on each of the seventeen divisions of subject matter in addition to the editors of the different volumes.

Although little progress has been made with the literary task, the actual process of decentralization was at once begun by the government, resulting in the formation of thirty-two federated autonomous republics within what is left of the territory of the former Russian Empire. Although, owing to political considerations, these creations did not correspond exactly with the regions marked out by the geographers—some are larger and some smaller—a relationship is clearly apparent. Thus the Tatar Republic, established by decree of May 29, 1920, presents a slightly reduced version of the projected "Eastern Agricultural Province" of the commission's plan. Two republics, the Ukrainian and the Crimean, were set up in the proposed province of South Russia; while practically three such provinces were incorporated into the principal state with its capital at Moscow. A cursory examination suggests imperfections in both the plan of the commission and the action of the government; perhaps both are destined to undergo modifications. As regards the former, the political partition has led to an anticipation by local bodies of the general project of description. The Eastern Academy at Kazan, for example, proceeded to launch a rival "Geographical Description of the Tatar Republic," of which the first part appeared in 1922.

From the above-mentioned facts it appears that the studies of geographic, ethnographic, and economic specialists have influenced the recent territorial reorganization of Russia even more directly and from an earlier date than is indicated in the article on this subject published in the April number of the *Geographical*

Review. The twelve "economic regions" therein mentioned as having been outlined in 1922 are probably the twelve "provinces" of European Russia provided for in the scheme of the commission drawn up two years previous to that date and before the reorganization was actually begun. (For further discussion of the twelve economic regions, with map, see H. Blink: Rusland als landbouw productieland, *Tijdsch. voor Econ. Geogr.*, Vol. 15, 1924, pp. 89–118.)

J. V. FULLER

AFRICA

Ghardaia: A City of the Desert. On the threshold of the Algerian Sahara lies the plateau of the Shebka, 8000 square kilometers in area, a country that might have come out of Dante, stony desert, *hamada*, in all its horror. "Without fear of contradiction it may be said that the world has few regions so disinherited." Here where it would seem that "the sole idea of human establishment would be in defiance of the natural conditions of soil and climate" are the oases of Mzab, and in them the peculiar and highly individualized characteristics of oasis settlements are illustrated surpassingly well. These oases have often been described. Brunhes took them as one of his oasis types, especially describing the struggle for water therein. A recent work by Marcel Mercier (La civilisation urbaine au Mzab: Étude de sociologie africaine, Algiers, 1922) discusses them as urban communities, from which viewpoint they are entirely distinctive.

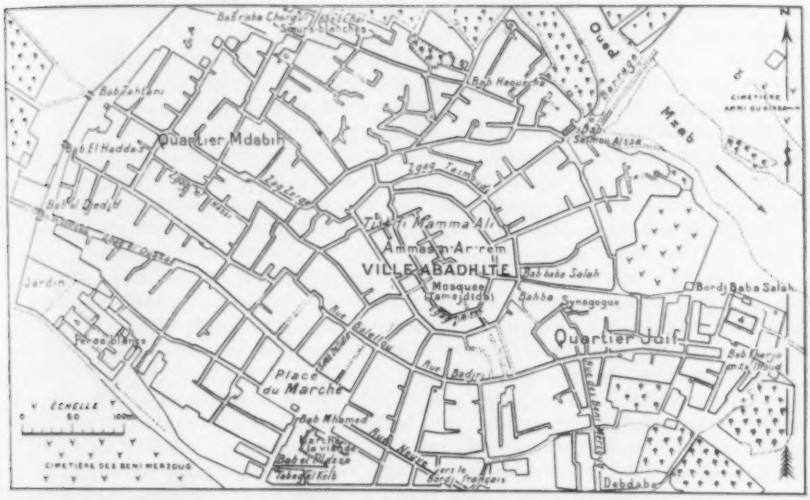
The desolate Shebka appears not to have been inhabited in prehistoric times; but it was anciently a land of transit, and toponymic features point to occupation by an Arabic-speaking people before the arrival of the present occupants, the Beni Mzab. The Beni Mzab are Abadites, a heretical sect of Islam, who fled thither in the eleventh century. In 1011 the first of five cities in the Wadi Mzab was founded; within the ensuing 50 years the four other cities. Five centuries later three other settlements were established at some distance. Founded as cities of refuge, the settlements must at first have been predominantly agricultural in character; but their situation in a transit land inevitably led to commercial development. Today the total population of the Mzab is 43,000 (census of 1921). Ghardaia, the chief city, has 11,000 inhabitants and best exhibits the urban characteristics of the Mzab settlements.

The appearance of the city from the distance proclaims the urban stamp. Rising out of an arid landscape it has itself a bare appearance: a mass of serried white or grey houses rises tier on tier up the sides of a butte crowned by a quadrangular minaret; not a tree is to be seen. The city is well-ordered in plan, quite unlike the usual Saharan town, groups of houses scattered haphazard in the midst of palm groves. This distinction from the "nonchalant insouciance" of the Saharan architects betrays the origin of the Mzab in the Tell. And herein the cities of the Mzab have a unique interest. Like all isolated communities the Mzab are intensely conservative; newer cities as well as the older ones preserve features largely lost elsewhere through successive Arab invasions.

Ghardaia exhibits, at least to some degree, a feature that Sten De Geer has emphasized as a criterion of urban development—differentiation into subregions according to function (cf. Sten De Geer: Greater Stockholm: A Geographical Interpretation, *Geogr. Rev.*, Vol. 13, 1923, pp. 497–506). The heart of the city is the mosque, on the culminating point of the butte. The town grew around it, as the medieval city of temperate Europe grew around cathedral or castle. The mosque is at the same time the citadel. Here is guarded the city treasure, and provision is made for time of siege. It is the moral and social center; the seat of the religious government, the schools, baths, prison. Houses are ranged around on concentric streets occupying the sites of old fortifications, pushed farther and farther out as the city expanded. The inhabitants recognize the distinctive character

of this section, giving it a special name signifying "center of the city." Here no outsider may take up his residence.

At the base of the hill the new town envelops the old, and here the streets are straighter. A secondary center, of economic character, has developed in the south and southeast, where the ramparts have been dismantled. Occupying a typical marginal position in the southwest is the market place. Daily and weekly markets are held, the latter only assuming real economic importance. Here on Thursday evenings gather the nomads who bring the town a large part of its provisions.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Quartier Juif
Place du Marché
Oued Mzab
Bab Zahlani
Bab El Hadda
Bab el Dzaïdi
Bab Sidi Aïssa
Bab Mhamed
Bab el Kebir
Bab el Kalâa
Bab Ouled Sidi Brahim
Bab Ouled Sidi Mezzi
Bab Ouled Sidi Saïd
Bab Ouled Sidi Abdallah
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Bab Ouled Sidi Abdelhalim
Bab Ouled Sidi Abdelhadi

covered, part terrace. A zoning law is in operation as regards height, which must not exceed six meters in the center of the town, seven meters outside it, and eight meters in the oasis gardens. There are 1815 houses altogether in Ghardaia, which gives an average of nearly six persons to a house; that is the individual family unit and not the kinship unit customary in Islamic countries. The houses are close-pressed; and, while the court is of fair proportions, the rooms opening off are small and narrow. The city of Ghardaia occupies 21 hectares (52 acres). The density of population thus is 476 per hectare, a figure of distinctly urban order. M. Mercier compares it with Paris with 128 persons per hectare in the residential section of the Champs Élysées and 741 in a poor and crowded quarter. The Borough of Manhattan, New York City, has 400 persons per hectare.

There is no production of food in the city itself. Even the goats, of which each family possesses one, must be sent out to pasture. Ghardaia has four goatherds. Every morning at a fixed hour they betake themselves to the appointed city gate "et fait entendre certains cris très prolongés au même instant, les portes des maisons s'entr'ouvrent, les chèvres sortent des habitations, se rendent d'elles-mêmes auprès du berger qui les attend et se groupent sur la petite place." They set out at sunrise and return only at sunset, going more than 20 kilometers for pasture.

Outside of the cities, to which they present the sharpest contrast, are the oases proper. These fresh, luxuriant gardens, unlike many oases where stagnant water exists, are very healthful for they are irrigated from well water quickly absorbed by the soil. That of Ghardaia is a kilometer and a half from the city and extends for three kilometers up the wadi. In summer the heat renders the city almost uninhabitable, so that the entire population betakes itself to the oasis, moving *en masse* in a single, moonless night, when the edict for exodus is given. Formerly temporary shelters were used; but within the last 50 years, it is said, permanent houses resembling those of the city have been built. Here is in evidence the feature common to all oasis settlements—the question of water supply. Ancient and precise regulations are in operation for its management and distribution, and therein is created a solidarity and democracy that counteracts the tendency to hierarchy in the city. Furthermore, the garden villas are larger than the town houses and accommodate the kinship group. Seeing the spaciousness of the gardens, once access is gained through the heavy wooden doors like those of the town houses, one would have no idea of the state of subdivision that exists; single palms are not infrequently the subjects of special property rights, but the irrigation canals are common property. During winter there is a constant coming and going from town to oasis; in summer it is reversed, the town being visited only for business matters and on market days. The gardens, however, are not pleasure resorts but places of exploitation. Their care demands unceasing labor.

It would be interesting to compare the cities of the Mzab with Siwa. This oasis of the Libyan desert, so famous for its dates, has been charmingly described by C. Dalrymple Belgrave in a recent book, "Siwa, The Oasis of Jupiter Ammon" (London, 1923). Siwa also is peopled by an ancient Berber stock and is built on the summit and sides of two limestone rocks rising abruptly from the plain. As the population increased new houses were built on the top of old ones, so that the inside of the town is now "a vast warren." More recently the town has spilled out on the plain; and here are country houses, where the wealthy retire in the summer when the heat of the town becomes intolerable.

Life in Timbuktu. Life in Timbuktu, the Mysterious City, is not the lotus-eating existence of some European travelers' descriptions. The hard facts are presented by Dupuis-Yakouba, Chief Agent of Native Affairs for French West Africa, who declares that "la plus grande activité règne dans cette région et qu'il

faut aux habitants de Tombouctou une ingéniosité de tous les instants pour arriver à se procurer nourriture et vêtements." In "Industries et principales professions des habitants de la région de Tombouctou" (*Publs. Comité d'Études Historiques et Scientifiques, Gouvernement Générale de l'Afrique Occidentale Française*, Paris, 1921) he gives a truly living picture of the industrious workers of the city and its district. Most of the city dwellers are engaged in commerce, but in the region as a whole a great variety of occupations is represented—from butchers, provisioned largely from the flocks of the nomads, and bakers to the "professions sanitaires." Most fall in the groups of manufacturing, extractive, commercial, and agricultural industries. Personal initiative is largely paralyzed by the existence of a sort of caste system; the exercise of most trades is hereditary. Shoemakers, for instance, are descendants of the Moroccan invaders of the sixteenth century.

The volume is furnished with abundant illustrations of instruments and products: thus for the building industry, which is not a closed trade, we have sketches of the mason's tools and plans and ornamentation of houses. Many interesting details are given. The houses, for instance, never face east or west, the directions of the prevailing winds, that they may be saved "the ills and malignant influences carried by the wind." Fishing—the chief extractive industry, for the Niger is extremely rich in fish—is illustrated by drawings and descriptions of 27 species of fish and illustrations of the canoe, nets, lines, and harpoons used. Fishing entails a seasonal movement. At the time of low water the fishing folk disperse to their favorite grounds to make and dry their catch; then the women and children return to the villages while the men peddle the fish in the towns.

The many intimate details include the cost of rent and laundry. In spite of the modesty of the rental, from 2 to 2½ francs for a room and from 10 to 15 francs for a house per month, a landlord in Timbuktu can thereby meet the daily expenses of his family. A laundress gets 25 centimes a garment if she provides her own soap and bluing (indigo). Among auxiliary industries hairdressing offers much scope, for coiffures are elaborate and varied according to race, state, and condition. Timbuktu is a desert town; its reservoirs, excavations in the sand filled by infiltration from the Niger, often dry up, wells are salty, and drinking water is retailed from house to house. Such water formerly cost .02 to .03 centime per skin bottle; now raised to .05 centime. The class of professional entertainers includes musicians and story tellers. The public gatherings of the latter have been largely curtailed, for under French régime curfew rings at 6 P. M. in Timbuktu! This is perhaps a little unfortunate, the harmless entertainment being "une des manifestations de contentement publique, l'indice de la tranquilité politique des habitants." The liberal professions number *imams* and *muezzins*, engaged in the service of Allah, the cadis and village chiefs, public letter writers, and teachers. The "profession sanitaire" in Timbuktu is now limited to a veterinary, who, however, does more business as a horse dealer. There is no doctor at present; a Moroccan who formerly practiced the healing arts with remedies imported from his native land—"il les cédait naturellement contre un bon prix"—apparently made his fortune and retired.

But, as we have said, the absorbing interest of Timbuktu is in commerce. This city of some 7000 inhabitants (census of 1921) might be described as a vast covered market. There are two public market places which are given over to retail sale, purchases being made with silver or copper coin. The wholesale transactions are carried on in the houses and consist essentially of barter of salt for grains and stuffs. The city, in fact, lives on salt; and many industries, including the hostelries and transportation, are subsidiary thereto. This commodity comes from the Taodeni mines, 18 days' journey to the north. The mines are worked by slaves of rich Moroccans or people of Aruan, from which latter oasis or from Timbuktu the mines are provisioned. Two annual caravans bring in the salt to Timbuktu, and it is sold largely to the Mossi who distribute it through the Niger bend. A minor occu-

pation is that of the salt markers, who inscribe the bars with an invocation to a saint and an ornamental design at 2 centimes apiece.

The Climate of Khartoum. Scorching hot days in summer, with hot nights too; hot days even in winter, but the nights cool; searing aridity, at times with no moisture at all in the air and for rain a dozen showers in July, August, and September, when southerly winds and a few clouds replace the steady northerly winds and fearful glaring sky of the dry time—more than half of these showers thunderstorms following *haboob* sandstorms, which blow for three or four hours a brisk gale, only agreeable for its welcome cooling. Such is the general picture of the "dry and scorching climate of Khartoum" (L. J. Sutton: The Climate of Khartoum, *Egyptian Ministry of Public Works, Physical Dept. Paper No. 9*, Cairo, 1923).

Once in the last 21 years the thermometer went up to 117°. Never since 1901 has it failed to climb up to at least 109° some day in May or June. In 18 years out of the 21 it has done it in April, and nine times in July. It is the accustomed thing in May and June to see the mercury reach 103° at noon, go on to 107° at about half past three, to settle back at 103° at six! Most terrific afternoons. There is little variation from day to day, and two months like that are to be expected.

The nights do not give much relief. Just before sunrise, the usual coolest moment in these two months, the temperature is at 80°. Occasionally it drops to 72°, and once in 21 years it fell to 67.5°. That is the lowest record for May and June. Within doors, where it is always much hotter than out at the thermometer shelter, it seems as if those must be bad nights to sleep. No doubt observers on the ground could tell us interesting things about that. Even in January, the coldest month, the afternoons as a rule warm up to 86°; occasionally to 95°; and once a temperature of 102° was recorded. But then the nights are cool, dropping to 59°; occasionally to 49°; there is one record of 40.3°, the lowest venture of the Khartoum thermometer, so that frosts are quite unknown and unlikely.

As Khartoum is within the tropics the temperatures are very regular, the means of successive days rarely differing by 2°. In rainless November this variability falls to 1.6°; in August, month of most showers, it rises to 2.7°. The greatest change ever known in two successive days was from the 12th to the 13th of July, 1907. A rainstorm on the second day dropped the temperature from a mean of 89° to one of 75°. Details, which are not given in the report, would be interesting. The August rains are explicitly stated to be cooling.

The air is extremely dry: at times the relative humidity is practically zero. "On occasion the air is dry enough to dry up calcium chloride exposed in the shade." The average relative humidity for the year has the extremely low value of 28 per cent, ranging from 13 in April to 49 in August.

The rainy season—it should rather be called the season of the rains—is from May to October inclusive. There are only five showers in August, the rainiest month, even if you count a tenth of a millimeter as a shower, which is exaggeration. Four or five good showers usually give August its 2.72 inches of rain. May has 0.12, June 0.28, July 1.77, August 2.72, September 0.71, and October 0.20—in all 5.83 inches for the year. The driest year, 1901, had 2.52 inches; and the wettest, 1922, 14.40. The rains are closely associated with the winds. No rain falls from November to April, while the wind is steadily northerly. In the season of the rains calms are three times as frequent, and nearly half the winds are southerly—25 per cent southwest, 17 south, and 4 southeast. Twenty-four per cent of the winds are still from the northern quadrant. The rains come on as a low barometer area advances from the south to establish itself over the Red Sea in July and August.

As already stated, there are not many showers. Sixty per cent of them are thunderstorms, frequently succeeding *haboobs* which thereby acquire climatic im-

portance. But what is a *haboob?* The picture is not very clear: "a very unpleasant type of sandstorm" met with more or less frequently throughout an area of about a half million square miles around Khartoum. At that station they have twenty or thirty a year. They come at all seasons but are four times as frequent in the six months of the rains. Their winds, never measured nor even estimated apparently, are only exceptionally strong enough to unroof verandas, overturn light Decauville tramcars, uproot trees in exposed places, and overturn river steamers. The *haboobs* of the dry season mostly come from a northerly quarter. In the season of rains, however, almost all come from the south or from points between south and east. Mr. G. W. Grabham, the Sudan government geologist and the observer from whom most information seems to be drawn but who is unfortunately not quoted, regards them as a collection of traveling, circular storms. This is well shown in two photographs (facing p. 54). The dust is frequently raised to heights of 1000 meters. "Within the storm the wind direction certainly varies. The frontage of the storm probably reaches twenty or thirty kilometers." They last three or four hours, "are very frequently accompanied or followed by lightning, and in July, August, and September by rain, and there is invariably a subsequent fall in temperature." It is not quite clear whether that means that the dry season *haboobs* also cool the air or only the rainy ones. Considering that 175 of them were recorded within 6 years, that is a very meager account.

But the element of human reaction to the weather is one of which little use is made in the report. The human body animated by an observant mind is an instrument that, within very definite limitations, has a high value for climatology and for meteorology; witness the most instructive personal narratives of experiences in many parts of the world that Hann used so effectively in the second and third volumes of his "Klimatologie."

Most of us never experienced anything like the climate of Khartoum. How do white men get along with it? What defenses do they adopt? Do they have to recuperate occasionally in other climates? Do they quickly suffer in health? In what way does it affect them? Have the natives good health? Mr. Sutton gives us typically the following. "The dry heat of May and June is very trying, but some relief is brought by the drop in temperature which accompanies the rains of July and August." On one or two occasions reference is made to descriptions by Mr. J. T. Hirst, the resident observer, and by Mr. Grabham; but there are no quotations from them. Khartoum has no thermograph, no barograph, no automatic recorders of either wind or rainfall. Such instruments would have surely shed much light on the *haboobs* that figure here so tantalizingly and on that drop in the temperature of July, 1907; but lacking these the observer's notes would certainly have been worth publishing. Abundant experience with reports published by meteorological journals has shown that the most admirable discussions of climate have been made by men who combined instrumental measurements of various phenomena with the workings of an observant mind, especially as this reacts at once on the instrumental record by adding opportune special readings in weather emergencies. Publication of his notes with such editing as they may demand reacts on the observer by keying up his attention and sharpening his power of observation.

The greatest of all climatologists set an example in that regard that might well be followed. Geographers owe an unpayable debt to meterologists and climatologists for every observation they have made and every instrument they have constructed or set up. We are grateful for all their work. We like their critical attitude with regard to their instruments and their exposure. We are grateful for the pains they take to average and add and smooth our curves by harmonic analysis; but respectfully we set forth that they are dependent on intelligent observers from the start and that an intelligent observer can report many climatological items that no instrument can record.

AUSTRALASIA AND OCEANIA

Depopulation in Melanesia. The decline of population and of the well-being of the native in many parts of Melanesia is the cause of grave concern to informed observers. The reception of two articles on the subject by the Melanesian Mission has resulted in the production of a slim volume of essays by authorities well known in Melanesia as administrators and students (W. H. R. Rivers, edit.: Essays on the Depopulation of Melanesia, with a preface by Sir Everard im Thurn, Cambridge, 1922).

FIG. 1—Sketch map of the New Hebrides showing the preponderant movement of depopulation.

The book deals with the New Hebrides, the Solomons, and the intervening groups of islands. There is no census in most parts of Melanesia. The facts presented are hence based on scientific method only in Rivers' essay. Elsewhere they depend on estimate and opinion, which, however, are trustworthy. The accompanying map indicates the existing conditions in the New Hebrides, as far as they have been stated in the volume.

The seven essays and introduction to the volume are contributions from unusually able authorities—men with a firm grip on Melanesian affairs and years of local experience behind them. All agree on the serious nature of the problem and agree in general as to its causes and treatment. At the root of the matter seems to be the disintegration of the native social fabric by the white man, who has given nothing in return except in a few meager examples, as in the New Hebrides where the missions, by grafting Christianity on to the native social organization, have effected a transfer from barbarism while retaining its better elements. This, as on Tanna, has been brought about by the policy of Sir William Macgregor in New Guinea—the upholding of native authority by capturing the interest and co-operation of native chiefs.

Opinion is expressed that the movement of depopulation in Melanesia was in progress prior to the arrival of the whites, owing to decadence in native society. The criteria of decadence are vague. Unnecessary exaggeration of ritual, custom, and form suggest a line of inquiry. Such influence certainly operated in parts of the New Hebrides (Aneityum), and Monckton gives an account of weapons in the Trobriand Islands which indicates that the people had long finished with war as a serious business. Beauty of design and great size were more considered in the manufacture of spears and shields than their effectiveness as weapons. He also refers to the Papuans between East Cape and Cape Vogel as a miserable and decadent lot (C. A. W. Monckton: Some Experiences of a New Guinea Resident Magistrate, 4th edit., London, 1921). Evidently the possibility of progressive decline in parts of Melanesia, not in any way connected with white civilizing influence, is a point to be borne in mind, though the essayists are not in agreement about it.

The general decline now taking place is attributed by all the writers to certain phases of white "civilizing" influence. The proximate causes of depopulation are

those affecting the health of the native—the subtle spread of epidemics, especially those of a pulmonary nature, after the visits of apparently clean ships; the slower spread of other white man's diseases; the effects of alcohol, as in the southern New Hebrides; the wearing of unnecessary clothes. A deeper-lying cause is to be found in the effect of the plantation system on native society. The recruiting of labor is still a bad business, and in the New Hebrides the methods vary—French planters may recruit women, while British may not. Terms of indenture and the conditions on many plantations are open to improvement. The home village is deprived of its marriageable young men (and perhaps women) for years. The repatriate has "seen life" and returns with the opinion that his chief is after all no very important person and that village life is pretty slow. He livens it perhaps by setting up business as a chief himself; and the hold of local government is weakened, while the recruiting vessel becomes a haven of refuge for criminals. For all these evils, feasible measures of administration are suggested.

But the root of the matter lies deeper still. Rivers' essay on "The Psychological Factor," strongly endorsed in Sir Everard im Thurn's preface, is perhaps the most important one in the book. Rivers advances his conclusions with no great emphasis, and it requires a knowledge of the man himself to realize their weight. A man of unusual brilliance and perhaps the ablest psychologist of Great Britain, he studies Melanesian anthropology in a rigorously scientific way, evolving novel and original methods such as the pedigree method of studying native population (for an account of Rivers' work see C. S. Myers: The Influence of the Late W. H. R. Rivers on the Development of Psychology in Great Britain, *Rept. British Assn. for the Advancement of Science, 1922*, London, 1923, pp. 179–192). Briefly Rivers' conclusion is this: The Melanesian has lost his interest in life. The tremendous psychological consequences of his spiritual condition are resulting in his extermination. It is shown, for instance, that the pursuit of head hunting in the Solomons was interwoven with the whole fabric of his religious and social life. The complete suppression of this pastime, without making adequate substitution for it, amounts to taking the springs from a clock. Primitive society is a complicated structure built out of elusive things (see H. Newcombe Wright: Primitive Law and the Belief of the Survival of Death, *Law Quarterly Rev.*, Vol. 34, 1918, pp. 380–391). Interference with it is only justified on the basis of a thorough appreciation of the significance of its manifestations to the native mind. Melanesian society has been ruined for the most part by good intentions. New Caledonia, the Loyalty Islands, and Fiji are not considered; but the depopulation of Fiji has been investigated, the "Suva Report" being well known (Report of the Commission Appointed to Inquire into the Decrease of the Native Population [Colony of Fiji], Suva, 1896).

Petroleum Prospecting in Australia. Competent judgment, within or outside Australia, has never endorsed the popular belief that commercial supplies of Australian petroleum must exist. In so large a country, where detailed geological investigation has covered a relatively small proportion of the ground, similar and well justified reserve in qualified opinion has caused geologists to refrain from a dogmatic assertion that oil will not be found. The government geologist of New South Wales has now expressed a matured opinion (E. C. Andrews: Prospecting for Petroleum in Australia, *Econ. Geology*, Vol. 19, 1924, pp. 157–168). He reviews the history of mineral prospecting in Australia, showing that the work has been done by capable men whose trained eyes were eagerly seeking all the profitable deposits of the earth's crust. None of these men encountered petroleum in commercial quantity. He then reviews the results of petroleum prospecting in the individual states. Beyond several indications of a none too promising nature, the results have so far been negative. The geological structure of Australia is then

considered briefly in a comparative way. He shows thus that the relation of the Australian land mass to the nearer commercial oil regions is similar to that of Peninsular India and South Africa—regions that have yielded nothing yet to prospecting. Mr. Andrews concludes by saying "If we may judge by the experience of oil prospecting outside Australia, the value of the expectation of securing crude petroleum in commercial quantities within the area under consideration is small and is not to be considered as a business proposition by small investors."

POLAR REGIONS

The Voyage of the "Quest." In "Shackleton's Last Voyage: The Story of the *Quest*" (London and New York, 1923) Commander Wild sets out to relate "a plain and simple narrative . . . the more popular story of the expedition" leaving scientific results for separate publication. The narrative is indeed told with admirable restraint; and at the same time, with the appendixes by various scientific members of the personnel, it gives a good idea of the character of the results attained. It is clear that there was accomplished a considerable part of the program, the main object of which was "the taking of observations and the collection of scientific data in Antarctic and sub-Antarctic areas" and which did not aim "at the attainment of the Pole or include any prolonged land journey." It will be recalled that Sir Ernest Shackleton's original plans had to be changed—from exploration in the Beaufort Sea and the region of Stefansson's "Pole of Inaccessibility"—to the Antarctic. The *Quest*, selected with a view to Arctic exploration, proved less suitable for Antarctic waters; and, furthermore, the expedition was handicapped by engine trouble throughout. This caused, for instance, a month's delay at Rio on the outward journey. The *Quest* sailed from Plymouth September 24, 1921, and reached South Georgia January 4, 1922. On the way one objective was visited, the St. Paul Rocks. Geological specimens were collected, and a new large-scale chart (200 feet to the inch) of the rocks and the surrounding submarine plateau was made.

In South Georgia the expedition was overwhelmed by the sudden death of the leader. Command now devolved on Wild who, in a situation rendered specially difficult by the delays encountered, decided to carry out the original plans as far as possible. The route lay eastward. A running survey of Zavodovski Island, the northernmost of the Sandwich group, was made. The nonexistence of Pagoda Rock was practically proved, a sounding of 2980 fathoms being obtained two miles east of the charted position. The *Quest*, now several degrees within the Enderby Quadrant, was headed south into the pack. She was pushed through the ice with increasing difficulty to latitude 69° 18′ S. and longitude 17° 11′ E. Shortly before attaining this position a depth of 1089 fathoms had been found. This represented a shoaling of 466 fathoms in 29 miles and suggested approach towards the continental shelf. "I felt sure that if we could only work our way for another fifty miles to the south we should sight or find indications of land," says Commander Wild. But it was not possible. Reluctantly the *Quest* was headed north and worked to the margin of the pack, along which she skirted for some 2500 miles to the westward. Whilst in the Enderby Quadrant her course lay approximately between that of Bellingshausen (1820) and Biscoe (1831). At 64° 11′ S. and 46° 4′ W. the *Quest* was within 40 miles northeast of the position assigned to Ross's "appearance of land," but no indications of land could be discerned though the day was clear: soundings gave a depth of 2331 fathoms.

The *Quest* proceeded westward as far as Elephant Island, a spot of vivid memory to those members who had been of the *Endurance* party in 1916. It was not possible to land at the old quarters, but a rough survey was made of Cape Lookout

anchorage where a supply of sea elephant blubber was obtained to eke out the coal until South Georgia could be reached. At South Georgia a series of over two hundred soundings was taken; it was shown that the 200-fathom line extended much farther to the southwest than had been believed. Possibilities of trawling and the establishment of a fish-curing station are indicated. Sketch charts of several of the harbors of the island were made.

FIG. 1—The route of the *Quest* in the southern hemisphere. Based on the map (p. 79) accompanying Commander Wild's paper "The Voyage of the 'Quest'," *Geogr. Journ.*, Vol. 61, 1923, pp. 73–105.

The *Quest* now proceeded to Cape Town, visiting the Tristan da Cunha-Gough Island group on the way. Investigations were made on the geology and natural history of the several islands, and elevations were taken. The highest point of Tristan da Cunha was reduced from 7640 feet to 6400. Dr. A. H. Macklin took a census of the population and to the volume contributes two interesting chapters on the islanders. Few signs of degeneration were found; the people were rather regarded as intelligent and healthy. Dr. Macklin, however, calls attention to the occasional introduction of new blood through temporary settlement of shipwrecked sailors. Tristan da Cunha is on the direct route from Cape Town to Buenos Aires, and the aviator member of the party considers that a good site for an aerodrome is available. The reported guano deposit of Nightingale Island was proved to be of no economic value. Gough Island offers much of interest in landscape and vegetation. Here the expedition spent five days, the only scientific expedition that had visited the island previously being that of the *Scotia* in 1904, which spent one day there. A new chart of the island was made with important corrections. The highest point, named Mt. Rowett in honor of the patron of the expedition, is situated centrally and has an elevation of 2915 feet; previous charts recorded 4380 feet in the northern part of the island. A reef reported by whalers in latitude 35° 4′ S. and longitude 5° 20′ W. was proved nonexistent. On the homeward trip from Cape Town St. Helena, Ascension, St. Vincent (Cape Verde Islands), and the Azores were visited, primarily for comparative geological purposes.

Arctic Tides and the Hypothetical Arctic Land. Northward of Alaska lies the vast unexplored region surrounding what Stefansson has called the "Pole of Inaccessibility." Whether this region is land or sea is still an open question. After his discovery of ocean depths along the route of the *Fram*, Fridtjof Nansen, in a series of detailed studies, concluded that the Arctic Ocean comprised an open basin of deep water occupying all, or nearly all, of the unexplored area north of the known land masses. ("The Oceanography of the North Polar Basin," London, 1902; "The Bathymetrical Features of the North Polar Seas, With a Discussion of the Continental Shelves and Previous Oscillations of the Shoreline," London, 1904; "On North Polar Problems," *Geogr. Journ.*, Vol. 30, 1907, pp. 469–487 and 585–601). But from a detailed study of the tidal and current data of the Arctic, R. A. Harris found it necessary to reduce the extent of the open polar basin and to assume an area of shallow water, an archipelago, or a tract of land to the north of Alaska. ("Some Indications of Land in the Vicinity of the North Pole," *Natl. Geogr. Mag.*, Vol. 15, 1904, pp. 255–261; "Arctic Tides," Washington, D. C., 1911, pp. 90–103; "Undiscovered Land in the Arctic Ocean," *Amer. Museum Journ.*, Vol. 13, 1913, pp. 57–61).

The tidal observations that Harris had at hand were very meager; and the cotidal chart he constructed to show the progress of the tide in the Arctic was necessarily based, to a considerable extent, on theoretical considerations. Along the north coast of Siberia, from the mouth of the Yenisei River eastward to Pitlekai on the Chukotsk peninsula—a distance represented by more than 100° of longitude—no tidal observations of any kind were at hand.

This question of Arctic tides and their bearing on the existence of undiscovered land to the north of Alaska, Jonas Ekman Fjeldstad considers in a preliminary report on the tidal observations made by Amundsen's party aboard the *Maud* during the years 1918–1921 ("Litt om tidevandet i Nordishavet," *Naturen*, Vol. 47, 1923, pp. 161–175). During the winter of 1918–1919 tidal observations for a period of three months were made at Maudhavn on the north coast of Taimir Peninsula (approximate longitude 105° E.); during the winter of 1919–1920 a series of observations covering eight months was obtained at Ajon Island (longitude 169° E.); and during the winter of 1920–1921 observations over a period of six months were made at Cape Serdze Kamen (longitude 172° W.).

On the basis of the tidal data secured by Amundsen's party, Fjeldstad constructs a new cotidal chart showing the progress of the semi-daily tide for the greater part of the Arctic. This cotidal chart differs considerably from that of Harris, for Fjeldstad assumes an uninterrupted channel across the pole from Greenland Sea to Bering Sea. It is interesting to note, however, that from the results of these tidal observations he considers that the depths assumed by Nansen for the unexplored region are somewhat too great.

Fjeldstad concludes that in so far as the semi-daily tides are concerned there is no need of postulating the existence of a large land mass in the Arctic, though shallow water and perhaps islands may be found north of Beaufort Sea. But he gives little consideration to the daily tide and none to the direction of the current, so that Harris' arguments for the necessity of a tract of land, an archipelago, or an area of shallow water in the Arctic cannot be considered as invalidated by the recent tidal observations. It is to be hoped that the *Maud's* drift across the Arctic will shed further light on this interesting geographic problem.

H. A. MARMER

Notes on Surface Markings in Spitsbergen. Under this title J. S. Huxley and N. E. Odell discuss the curious polygonal markings occurring on fairly level surfaces in high latitudes or high altitudes (*Geogr. Journ.*, Vol. 63, 1924, pp. 207–229).

A large surface is found to be covered with a polygonal pattern, the common borders of the polygonals being made up of large stones, and the interiors of finely comminuted mud. The polygonals vary in size from less than a foot to 60 feet or more across; but in any one area the sizes are fairly uniform. Sections across them show that the mud extends down five to ten inches to the frozen soil below and that under the stone border there is a small gutter in the frozen soil. It is these curious forms that the authors describe and illustrate with pictures and diagrams.

They cite the two most important hypotheses that have been advanced to explain the markings. But first we may lay down certain fundamentals: (1) the material is derived by frost action from the underlying rock, or from an old moraine. (2) The markings are due to frost action, as they occur only in places where this is active. (3) The stones in the border have been moved outward by a centrifugal force, for the mud is often rucked up against the stones and frequently has gentle undulations throughout; the stones, if flat, stand up on edge; where an isolated form occurs, it is circular; where many occur in juxtaposition, they are polygonal; all indicate pressure from the various centers.

Högbom found that stones in a finer water-soaked matrix, subjected to repeated freezing and thawing, were brought to the surface, though he offered no satisfactory explanation. He explains the polygons by supposing that the matrix, expanding on freezing, pushes the stones outwards; and, on thawing and contracting, the smaller particles but not the larger stones are drawn back; thus in time all the larger material would be collected at the border. Nansen thinks that such a process would not be effective until a fair amount of fine material had been developed and suggests that it is preceded by nivation about small snow patches. This seems rather supplementary than contradictory to Högbom's ideas.

The authors accept both these views and add to them. They point out that the rate of comminution will increase as the material becomes finer; also that the large stones have a higher heat conductivity (better diffusivity) than the water-soaked mud; therefore during thaws they will melt the gutters in the ice, allowing the thaw water to run off and keeping the stones clean; the mud will retain the water by capillarity and be ready for the next freeze. They think that freezing begins at the surface of the frozen soil and not at the upper surface of the mud; this may be so at times but not at all times. A study of the propagation of temperature variations into the earth, making allowance for the water-ice latent heat, might clarify the outward movement of the stones.

Several other forms, related to the polygons, are described; and the observations are given in much detail. They are all considered transitional forms, changing slowly; frost action will finally comminute all the material. The fairly uniform size of the polygons in a given area and the varying sizes in different areas are not understood. Reference may also be made here to observations on an allied phenomenon in the French Alps by M. André Allix, "Nivation et sols polygonaux dans les Alpes françaises" (*La Géographie*, Vol. 39, 1923, pp. 431–438).

HARRY FIELDING REID

GEOGRAPHICAL NEWS

The Unveiling of the Memorial to Francisco P. Moreno. In November last the University of La Plata unveiled a memorial to Francisco P. Moreno, Argentina's foremost geographer, who died at Buenos Aires in 1919 (see *Geogr. Rev.*, Vol. 9, 1920, p. 69). In addition to his distinguished work as explorer and boundary commissioner, Moreno will be remembered as the organizer of the La Plata Museum, an institution specifically devoted to research. Moreno's work was recognized by the American Geographical Society in 1909 by the award of the Cullum Geographical Medal. On the invitation of the officers and council of the University

of La Plata the Society was represented at the memorial ceremony, Mr. Willing Spencer acting in this capacity. The following report is transmitted by Mr. Spencer.

On the afternoon of November 19, 1923, a few invited guests gathered in the central hall of the Museum for the unveiling of the bust of Dr. Moreno. There were present amongst others the President of the University, Dr. Benito Nazar Anchorena; the Minister for Foreign Affairs, Dr. Gallardo, with his wife and daughters; the Ministers of Government, Public Works, and Finance; Mr. Willing Spencer, Counselor of the American Embassy at Buenos Aires; Señores Casás, Rodriguez, Juarégui y Viale; the Director of the Museum, Dr. Luis María Torres; members of the family of Dr. Moreno, including Señores Eduardo Moreno, Francisco and Eduardo Moreno, Jr.; Dr. Ernesto Quesada; Sr. Clemente Onelli; and professors of the various institutes and faculties of the University.

After the playing of the national anthem Dr. Gallardo uncovered the bust of Dr. Moreno. Dr. Torres then initiated a series of speeches, himself reading an exhaustive biography of Dr. Moreno. Dr. Ernesto Quesada followed, speaking in behalf of the Historical and Geographical Institute of Brazil, which he represented. Dr. Quesada gave a brief history of the development of the Museum of La Plata. He went on to speak of Dr. Moreno's personality and in this respect said: "The outstanding features of Moreno's personality—leaving aside the appeal of sentiment—were, as you know, his decided scientific vocation, and the evident stamp of his autodidactic development, with all the advantages and shortcomings of such an *extra universitatem* preparation. All of Moreno's works during his entire life are touched with this mark and bear this unmistakable double seal. His determined vocation infused him with an energy which knew no obstacles, and the fact that he was self-taught led him to surround himself with specialists of methodical and solid preparation for whatever task he undertook, both inside and out of the Museum, in the practice of his duties as expert in the matter of boundaries, and in everything entrusted to his management. His observation penetrated the remotest corners. He marked out each course and directed it himself from the prow. He had technical experts execute what his intuition forecast; he saw to it that the work was done in the very best way possible and that it should stand out as an achievement. He was, in this sense, an ideal museum director. His own scientific labors reduced themselves little by little to the indispensable, until they became deliberately a mere side issue, so that he could concentrate thought and will to directing the work with energy, carefully selecting his collaborators, inspiring them at all times with an *esprit de corps*, and zealously supervising the accomplishment of their tasks. He was, in reality, a remarkable general-in-chief of a well disciplined army of exemplary training; he laid down definite rules and regulations for everything; he assigned to each his line of action; he was the stimulus of the whole working day, the very soul of the Museum, the incentive of its research, the instigator of the labors of the chiefs of sections, and it was he who made isolated endeavors converge in a common purpose, keeping always in view the advancement of national science. . . ."

The ceremony closed with a few brief words by Sr. Clemente Onelli, who made a presentation to the Museum of certain effects belonging to Dr. Moreno, to be kept in the institute as relics of the illustrious scientist, its founder.

Obituary

Prince Roland Bonaparte, President of the Paris Geographical Society, died on April 14, 1924, in his sixty-sixth year. A grandnephew of Napoleon, he was not concerned with royal aspirations but devoted himself rather to scientific pursuits. A number of his publications deal with the Dutch colonial empire. Three of these together cover the voyages of the Dutch to New Guinea from 1595 to 1885. Another

deals with the first settlement of the Dutch on the island of Mauritius. Several publications are devoted to ethnography. One of these, illustrated by anthropological photographs, discusses the peoples of the South American colony of the Dutch ("Les habitants de Suriname: Notes recueillies à l'Exposition Coloniale d'Amsterdam en 1883," Paris, 1884). He also studied the Lapps and the Kalmuks. Several papers deal with the glaciers of the French and Swiss Alps. To his family's ancestral home is devoted "Une excursion en Corse," Paris, 1891. He was a contributor to the valuable collective work entitled "Le Mexique au début du XX^{e} siècle" (2 vols., Paris, 1904), of which the 70-page section on population and colonization is due to his pen. His early predilection for historical geography is evidenced by the later publications "Documents de l'époque mongole des XIII^{e} et XIV^{e} siècles" (Paris, 1895) and "Les idées géographiques à travers l'histoire."

Since 1889 Prince Roland Bonaparte had been a Corresponding Member of the American Geographical Society, in the development of which he on numerous occasions showed a friendly interest. In July, 1921, he presided at the celebration of the Paris Geographical Society's centenary with the personal charm and democratic affability for which he was noted.

GEOGRAPHICAL REVIEWS

A Detailed Study in Mexican Anthropogeography

Manuel Gamio and Others. **La población del valle de Teotihuacán: El medio en que se ha desarrollado, su evolución etnica y social, iniciativas para procurar su mejoramiento.** Vol. 1, Part I: cii and 362 and xvi pp.; Part II: pp. 367–778 and xii; Vol. 2, 670 and xxx pp.; maps, diagrs., ills. Direcc. de Antropol., Secretaría de Agric. y Fomento, Mexico, 1922. 11½ x 8 inches.

The Valley of Teotihuacán is known to most travelers who visit Mexico as the site of the ancient monuments, the so-called Pyramids of the Sun and the Moon. It is more than that, however. It is the great natural highway from the east into the Valley of Mexico: a highway over which prehistoric migrations undoubtedly passed, through whose wide gateway armies of ancient and modern times have marched, and through which trails, roads, and railways have been built to connect the heart of the country with the almost equally populous eastern valleys of Tlaxcala and Puebla, as well as with cities along the Gulf coast. In fact, the selection of this site for those ancient monuments was probably due to its importance as a great natural highway.

Moreover, in this wide passageway existed several of the most ancient pueblos on the Anahuac Plateau. These scattered agricultural settlements, with their old stone and adobe houses, the ancient landmarks that bound their fields, and their irrigation systems, are of almost as great anthropological importance as are the clusters of prehistoric monuments about which they are grouped. Few spots in Mexico lend themselves so well for a study of the modes of life that have characterized man's occupation of this region.

It is this district, with its associations running back into hoary antiquity but still inhabited by the descendants of the ancient settlers, that forms the subject of study in Dr. Manuel Gamio's work, recently issued by the Mexican government's Department of Anthropology. The work in question is primarily an anthropological treatise, but it includes also a brief, systematic description of geographical conditions and throughout never loses sight of the geographical setting. Throughout the pre-Hispanic period, the colonial era, and the present times, in the minute description of the life and culture of the valley, human activities are shown to be closely related to the land. The reader sees how lines of communication developed along this great natural highway and its tributary valleys; how irrigation farming resulted from the scanty rainfall and the porous character of the soil; how the distribution of the people, the type of dwellings, the mode of clothing, the folklore, and the system of landholding are connected with the physical conditions existing in the region.

The descriptions are characterized by thoroughness of detail: in fact, few districts of the world have been the object of such detailed treatment. Numerous illustrations (drawings and photographs) together with many topographic and geological maps add greatly to the graphic character of the volumes.

Additional value is lent this work by the fact that, while in several respects the Valley of Teotihuacán differs from other parts of Mexico, in many ways it is a typical section of the populous Mesa Central which for ages was one of the centers of densest population and highest culture on the American continent. The work affords an excellent cross section of Mexican history and Mexican life as it exists upon the Central Plateau.

That such a study could have been carried on and almost brought to completion during the troubled years of revolution adds credit to the department that produced it and the guiding head of the enterprise.

Dr. Gamio has shown his often expressed desire to have the English-speaking scientific world take a keener interest in the affairs of Mexico, by issuing an abridged form of his study in that language (Introduction, Synthesis and Conclusions of the Work, "The Population of the Valley of Teotihuacan," by Manuel Gamio, Dept. of Anthropology, Secretaria de Agric. y Fomento, Mexico, 1922). Such a result will probably be obtained, and there will also result an increased appreciation of the work being done by such Mexican students as the author of these monumental volumes.

G. M. McBRIDE

The Plan and Site of Tenochtitlan

W. L. HARE. **The City of Mexico.** Maps. *Garden Cities and Town Planning*, Vol. 13, 1923, pp. 135–142.

The cities of a lost civilization are rarely known in plan as they existed when peopled. The reconstructions of archeology, however accurate, are skeletons. Mr. Hare has made a study of the valley of Anahuac, and of Tenochtitlán, primarily to understand the routes and movements of Cortes, whose own despatches were detailed in most essentials but vague in the important one of directions. From the maps and documents investigated Mr. Hare has presented four valuable maps. The first, a map of the valley of Anahuac, he has prepared from historical sources. It gives a clear conception of the site of Tenochtitlán and the occupation of the valley around Lake Texcuco at the time of the Conquest. The other three are maps of the capital, dating from 1524 (the city before the Conquest), 1555 (the rebuilt city after the Conquest), and 1772. The second and third maps are not to scale but are considered trustworthy in their expression of relations. The series forms a living geographical background for the Aztec capital and provides a starting point for the study of the geography of Mexico City.

Sketches of Scenery and Vegetation in the Arid West

P. L. MONNET. **Explorations botaniques: La Californie et les grands déserts américains: Notes et études.** With a preface by Gaston Bonnier. 244 pp.; maps, ills., bibliogr. Librairie Générale de l'Enseignement, Paris, 1922. 12 fr. 9 x 6 inches.

This book consists of descriptions of topography, geology, and vegetation in parts of California, Nevada, and Arizona, with a narrative of the author's travels in these states during the year 1913 and lists of the plants collected in the several areas. The preface by Professor Bonnier informs us that Monnet, whose father was at that time French consul general at San Francisco, returned to France to join his artillery regiment at the outbreak of the Great War and was killed in action in October, 1915, when only 22 years old. The book was written during intervals of activity at the front and was left incomplete, the narrative terminating at the beginning of the author's journey across Death Valley.

The regions treated are: San Francisco Bay country, Oroville and Feather River, the Redwood Forests of Mendocino County, Honey Lake Valley, Surprise Valley and Warner Range, southwestern Nevada (the Goldfield region), the Gila desert of southwestern Arizona, and Death Valley, California.

The briefness of the young author's acquaintance with the country he explored and the conditions under which the book was prepared give it necessarily the character of a series of sketches. American readers having access to other sources

of information will probably find in its pages little that is new to science; but the vividness of the descriptions of scenery and vegetation and the excellence of the style will commend the book even to readers who know these regions well. The southwestern deserts and their vegetation are so graphically portrayed in words as to render almost superfluous the numerous fine reproductions of photographs illustrating the volume. Not the least attractive feature of the book is its revelation of the author's essential friendliness. He shows a keen and sympathetic interest in the often picturesque human types encountered in his wanderings.

One cannot read this book without being impressed with the keenness of observation and the vital interest in science possessed by the author. Geographical distribution and the structural adaptations of plants to their environment were his favorite subjects. The plant associations of the regions visited are described briefly but with a skill indicating that, but for his untimely death, Paul Louis Monnet would have attained eminence in his chosen field of plant geography.

F. V. COVILLE

THE HISTORY OF ICELAND

KNUT GJERSET. **History of Iceland.** vi and 482 pp.; map, index. The Macmillan Co., New York, 1924. $4.00. 9 x 6½ inches.

The history of so isolated and individual a country as Iceland can hardly fail to embrace matters of geographical interest. While Dr. Gjerset's volume has little direct concern with geography—there is a short section on climate and natural resources—it affords interesting side lights, especially on the reaction of population movement to physical and political circumstances.

It was isolation that early attracted a comparatively numerous population to the island. Population at the close of the period of colonization (874–930) is generally estimated at some 25,000, a quarter of the present-day population (94,679, census of 1920); and some place the figure much higher. Furthermore, this population was selected: it was the aristocracy of Norway and the western colonies that here sought refuge and freedom, whence the advanced status and the early flowering of literature in the "saga island." An estimate for the end of the eleventh century gives a population of 50,000; towards the end of the eighteenth century it was only 40,000. Not only did the permanently difficult conditions of life tend to keep down the population, but the island was periodically swept by natural calamities. Dr. Gjerset enumerates the series of calamities that took place in the fourteenth century (pp. 240–242) and again in the seventeenth and eighteenth centuries (pp. 320–323). "During this [eighteenth century] century," he quotes, "Iceland experienced forty-three years of distress due to cold winters, ice-floes, failures of fisheries, shipwrecks, inundations, volcanic eruptions, earthquakes, epidemics and contagious diseases among men and animals, which often came separately, but often in connection with and as a result of one another." In consequence "the plan was even considered of removing the entire population from Iceland and colonizing them on the heaths of Jutland." The population has always shown itself sensitive to economic relations with the outside, and these have been influenced by the political control. The bad years of the early fourteenth century were in a measure relieved by the flourishing trade with Norway and the development of the export trade in dried codfish. The disasters of the eighteenth century were not retrieved until the general revival of commerce after 1814. Economic and political conditions are also reflected in the modern emigration of the latter half of the last century. There is an interesting note on the Icelandic "colonies" of the United States. During the last decades political freedom, formally granted in 1918, and economic progress have transformed Iceland into a prosperous and progressive modern state.

The Tatar Republic

B. N. Vishnevski, edit. **Geograficheskoe Opisanie Tatarskoi S. S. Respubliki, Chast pervaya: Priroda kraya. [Geographical Description of the Tatar Republic, Part I: The Nature of the Country.]** 279 pp.; maps and charts. Kazan, 1921. 10½ x 7 inches.

This volume contains chapters by different authorities on the extent, geology, topography, soils, climate, vegetation, and wild animal life of the country. All these subjects are capably handled from the specialist's point of view and yet made intelligible to the average educated reader by adequate explanations of the geographical terminology and principles involved. A vocabulary of scientific terms has been appended, as well as comprehensive bibliographies.

The Tatar Republic, with its capital at Kazan, is one of the federated soviet states formed in 1920 on the territory of the former Russian Empire. It embraces the region surrounding the junction of the Volga and Kama Rivers, the valleys of which, naturally, constitute the predominant features of its relief. The rock strata have not undergone folding and the type chiefly found next the surface is the variegated marl composing the topmost layer of the Upper Paleozoic "Perm formation." The territory was also not subjected to glacial action; but the ice sheet approached sufficiently near it to produce important effects in the form of alluvial deposits in the river valleys and a thick precipitation of loess transported by winds from the moraines. A long desert-steppe period converted this surface into the fertile *chernozem* which still comprises more than a third of the soil of the region. Over large areas, however, the soil has been degraded through the invasion of oak, fir, and pine forests, made possible by the very formation of the black soil, as well as by the advent of a somewhat more humid climate. Professor Gordiagin's excellent study of these forest régimes and their struggle for domination forms a valuable contribution to botany and forestry. He concludes, also, that further extension of these forests at the expense of the steppe has, as in the case of the American prairies, been checked since early times through periodic firing of the dry grass by men.

More than half the open land has been brought under the plow, being devoted almost wholly to grain crops. While the soil has held up well under this unvaried cultivation, it has proved a highly undependable staple resource, owing to the extreme annual variations in spring rainfall. In 1921, for example, this was less than one-quarter of the normal amount. The remedy suggested for the resulting famines is an increased culture of the potato, which is much less affected by spring droughts.

Apart from the general excellence of this work as a piece of geographical description, it is of especial interest because of the similarity between the region dealt with and the prairie lands of the United States.

J. V. Fuller

Cyrenaica in Survey

Olinto Marinelli, edit. **La Cirenaica: Geografica, economica, politica.** xi and 270 pp.; maps, diagrs., ills. Antonio Vallardi, Milan, 1923. 10 x 7 inches.

Under the auspices of the Italian Touring Club and with the patronage of the Colonial Government a party of Italian scientists traversed the plateau lying between Benghazi and Derna, visiting El Merj, Marava, Slonta, Cyrene, El Jubba, Tolmeta, and Marsa Susa during the fortnight of April 12–27, 1920. The results of their observations are set forth in the series of monographs composing the volume under review, which gives a varied survey of a region hitherto very imperfectly known.

The first study is that of Giuseppe Stefanini on the geological structure of the region, supplemented by a detailed appendix and particularly by a table of the geology of Cyrenaica as compared with Algeria, Tunis, Tripoli, and Egypt; and illustrated by a geological sketch map 1: 1,500,000. The general conditions of the relief are studied by the editor, with a sketch map and an appendix. Cyrenaica is divisible into a coastal plain (Sahel) of recent formation and a mountainous region (Jebel); and it is entirely calcareous, even the dunes being practically sandless.

Hydrography is studied by Leonardo Ricci with a sketch map. Apart from the *baltas*, or basins at an elevation of 150 meters on the southern borders of the pre-desert region, and the *sabkhas* ("salt lands"), or salt lagoons fed from the sea, south of Ghemines, as well as a number of ponds more or less permanent, there is a marked scarcity of surface water. Certain wadis are fed from springs, and there are numerous temporary streams; but all these are wholly inadequate for agricultural and other needs. All the wadis of Cyrenaica are short, the longest being probably the Wadi Derna (100 km.) and the most extensive basin (about 1100 sq. km.) being that of the Wadi El Kuf (65 km. in length). It is as yet difficult to trace the watersheds; and the effect of rainfall is still insufficiently known. Subterranean water certainly exists, though its volume is quite undetermined; and there are subterranean water caverns, as at Jok-Lete.

Climate is discussed by Ezio Mosna, at least as regards temperature, precipitation, and air currents; though data of value are recorded only for Benghazi, Derna, and Tobruk. In the cold (wet) season (October to March) the winds blow from the south, and from the north in the dry (hot) season (April to September). The mean winter temperature at Benghazi is 10° C., rising in summer to 30° and sometimes to 40°. The mean annual precipitation, which falls only in fixed periods, is less than 500 millimeters; so that Cyrenaica ranks as an arid region, though the plateau is less dry than the coast. There is, however, great variability in this regard, 617 millimeters being recorded for Benghazi in 1894 and only 137 in 1914. Rain is also brought by the west winds; but the hot, dry south winds of spring and autumn, usually beginning at evening and lasting several days, exercise an injurious effect on vegetation and animals alike. Acclimatization is easy, however, for southern Italians and Sicilians. The chapter is illustrated by a sketch map of precipitation and by charts of winds and rains at Benghazi and Derna.

The flora of Cyrenaica, which is discussed by Cesare Calciati, is less rich than that of Tunis and northern Algeria; it shares about 70 per cent of its non-endemic flora with Greece, 79 per cent with Tunis and Algeria, and only 52 per cent with Tripoli, the entire distribution being indicated by a sketch map. The author finds eight distinct zones of vegetation: (1) the desert, covered after heavy rains with brief-lived xerophilous growth; (2) the pre-desert; (3) the Sarval, about 65 kilometers square and less than 200 meters above sea level, well-watered, and producing barley; (4) the coastal plain; (5) the oasis of Derna (largely artificial); (6) the inland plateau; (7) the plain of El Merj (oats); and (8) the highland steppes. The fauna is studied by Alessandro Ghigi.

Notes on the ethnology of Cyrenaica are contributed by Francesco Béguinot. The ancient invaders—Phoenicians, Greeks, Vandals, and Byzantines—fused but little with the aborigines and penetrated scarcely beyond the coast line. The same statement holds true of the Arabs of the period of conquest in the middle of the seventh century; but a large minority (about one-third) of the Arabs of the period of invasion in the middle of the eleventh century were absorbed by the Berbers, though some small groups have preserved their ethnic unity. The Berber language, however, is spoken only in the Oasis of Augila by about 2000 persons; and there are but scanty traces of ancient traditions. Some stone implements have been found (cf. the appendix by Nello Puccioni).

Discussing the centers of population and the nomad tribes, we are informed by Ricci that there are but few towns, whether permanent or temporary—a condition which seems to have prevailed in antiquity as well. He estimates the population of ancient Cyrene (now Cirene) as between 20,000 and 25,000; of Apollonia (Marsa Susa) as 10,000; of Ptolemais (Tolmeta) as 8000; of Tauchira Arsinoe (Tochra) as 5000; of Berenice (Benghazi) as 5000; of the entire region as about 200,000. In 1817 only two centers were mentioned by Della Cella, Benghazi (5000) and Derna (500); but through the energy of the Senussi a marked revival began about 1840, and in the last decade of the nineteenth century the Turks encouraged immigration of Circassians, Kurds, and (especially) Mohammedan Candiots from Crete. Yet even now the country is occupied by nomads except for non-Arab and non-Berber elements; and the density of population, exclusive of the desert, is not even three per square kilometer (cf. the sketch map, 1:2,500,000, p. 103). Ricci estimates the population as 95,000 nomad and 50,000 sedentary, a total of 145,000.

The native system of agriculture is considered by Armando Maugini, its present condition by Antonio Belluci, and pasturage by G. L. Mainardi (pp. 135–142). The sedentary population is centered in the north, where no true nomadism exists; the seminomads sow grain wherever conditions permit (though these vary each year); and the nomads devote themselves to their flocks and herds, increasing the deforestation which is progressively injuring the land. The Mediterranean area might be made more and more agricultural, though the pre-desert zone must probably remain pastoral; but the backward character of the natives and their scanty needs and numbers (which are decreasing) form a grave barrier to any progress, to say nothing of the obstacles of native customs, particularly the quasi-communism of the Senussi and the system of land tenure (cf. Massimo Colucci's study of landed property in Cyrenaica, pp. 143–157). Furthermore, the evil heritage of the past is too great a burden to be speedily overcome; for it seems to be agreed that the decline of Cyrenaica from the prosperity which is attributed to it by classical writers is not due to diminution of rainfall or to deterioration of climate or to any other physical cause but to the historic factors of the fall of civilized alien rulers (notably the Greeks and Romans), invasions (such as those of the Vandals), and barbarous domination (as that of the Turks; cf. also pp. 46–48 and 167–171). Nevertheless, the Italian occupation, though dating only from 1911, while the Organic Law of Cyrenaica was promulgated only in 1919, has already brought some degree of amelioration.

The colonial problems of Cyrenaica are treated by Fabrizio Serra. He holds that a zone between sixteen and forty kilometers wide, extending from Tocra to Chersa and containing some 375,000 hectares, is ready for immediate agricultural use and that this area may easily be doubled. The communications now existing are listed. The chief immediate requisites are roads and ports (cf. Ermes D'Orlando's study on the port of Derna in the appendix); the necessity for a railway is not so clamant (the only one now existing is a narrow-gauge line of 35 kilometers from Benghazi to Regima); but when it is constructed, it should follow the southern limits of greatest production, thus being symmetrical with the coast from Benghazi to Derna. The chief difficulty is that of land tenure, though the problem is simplified by the Mohammedan law (taken over by the Italians) that the state enjoys the right of eminent domain. It should, therefore, be possible to make satisfactory arrangements with the natives if tact and justice are observed; and even the Senussi problem seems capable of equitable solution.

The volume contains two other studies of interest: Serra's monograph on the administrative system under the Turks and under the Italians and Pietro Vallardi's article on the school problem; but these fall outside the purview of the geographer. Only two matters seem to be missing: a brief survey of the history of Cyrenaica

and some account of its archeological remains; for though they are not required by the scheme of the expedition, they would have rounded out the work and made it a veritable encyclopedia of Cyrenaica. A bibliography would also have been welcome; but these are very minor objections in view of the excellence of the volume, which is concluded with a bathyorographical map (1: 1,000,000) of the region under consideration.

LOUIS H. GRAY

THE CLIMATE OF THE NETHERLANDS EAST INDIES

C. BRAAK. **Het klimaat van Nederlandsch-Indië (The Climate of the Netherlands Indies).** With English summaries. Vol. 1, Part I, v and 63 (Dutch) and 18 (English) pp.; ills.; Part II, iii and pp. 65–147 (Dutch) and 19–50 (English); maps, diagrs., ills.; Part III, iii and pp. 149–221 (Dutch) and 51–90 (English); maps, diagrs.; Part IV, iii and pp. 223–278 (Dutch) and 91–122 (English); maps, diagrs., ills. *Kon. Magnet. en Meteorol. Observatorium te Batavia Verhandelingen No. 8.* Batavia, 1923. 11 x 8 inches.

The Dutch have made careful observations in the East Indies for many decades, and some of the world's most eminent meteorologists, including Bergsma, van Bemmelen and van der Stok, have shared in the investigations. Braak, therefore, has a good foundation upon which to build for his treatise which promises to be a thoroughgoing piece of work.

The preface announces three volumes, the first dealing with general features, the second with the local climates of the different islands or groups of islands, and the third containing the climatological tables. The present review concerns the first four parts of Volume 1. Forthcoming parts of this volume are to discuss temperature and humidity; dew and fog; thunder and lightning; hail; deviations and disturbances; and (Chapter 13) comparison of the climate with that of other regions.

If the high standard of excellency set by the four parts already received is maintained in the remaining parts, this treatise unquestionably will be recognized as one of the very best discussions of the climate of a region. The parts already issued form in themselves a reference work of great value. Furthermore, several of the descriptions of weather and climatic conditions are so well done in the English summaries as to merit becoming classic in scientific literature. The general descriptions in Chapter 3 are excellent. The importance of slight differences in temperature are pointed out, 21° C. (70° F.) being a stimulating temperature for persons accustomed to the 26° or 27° (80° F.) prevailing near sea level. An elevation of 1000 meters is preferred in Java to higher stations, which are often chilly and subject to uncomfortably marked variations in humidity and to cloudiness. Chapter 4, dealing with winds, discusses monsoons satisfactorily and includes accounts of several destructive tropical cyclones especially near Timor (latitude 7° to 10° S.). Squalls in which the wind velocity exceeds 40 miles an hour are rather common, and several whirlwinds closely resembling tornadoes are described. The chapter on rain includes six large rainfall maps and many data, as well as a good discussion of time and place distribution. Chapter 7, Cloudiness and Sunshine, forms Part IV. It includes a good discussion of causes of cloud formation, descriptions of clouds, vertical and regional contrasts in cloudiness and types of clouds, mist, the percentage of sunshine in different months and places, and some interesting facts on the intensity of light. Braak reports that in the lowlands sunlight is considerably less than at Washington, D. C. (with the sun at the same angle). At high elevations, however, it is notably more. As haziness rather than invisible vapor shuts out the light and as rainfall sweeps away the haziness, the curves of sunshine intensity are roughly parallel with the rainfall curves.

STEPHEN S. VISHER

Two French Works on Weather Forecasting

J. Rouch. **L'Atmosphère et la prévision du temps.** 204 pp.; maps, diagrs., bibliogr. (Collection Armand Colin, No. 36.) Librairie Armand Colin, Paris, 1923. 5 fr. 6½ x 4½ inches.

Gabriel Guilbert. **La prévision scientifique du temps.** ix and 438 pp.; maps, diagrs., ills. Augustin Challamel, Paris, 1922. 10 x 6½ inches.

Captain Rouch of the French Navy was in charge of the meteorological services of both army and navy during the World War. His serviceable little book is written, as might be expected, from the viewpoint of a professional forecaster. There are no descriptions of instruments and but few directions for making observations. It is taken for granted that the reader is familiar with the basic laws of physics. Beginning with temperature, the author passes rapidly to pressure, hygrometry, insolation, cloudiness, and precipitation. In Part II the various chapters treat of the distribution of these elements; and then follow optical phenomena, cyclones, and anticyclones. In Part III the author speaks as one who has himself been actively engaged in the application of weather forecasts, short range and long range, for military purposes and also for agriculture.

He states that one of the first questions asked him when he became head of the meteorological service, was "What date had the least probability of rain?" The army chiefs were much concerned because the first battle of the Somme was impending. Records kept by the Messrs. Chandon brothers (1784–1869) at Montdidier, showed that on the 11th of August it had rained only 19 times, or 22 per cent of the total number of days. The dates with greatest probability of rain were September 23, when it rained 57 per cent of the time, September 22 and 24, October 8 and 18, and December 2, 4, 6, 17, and 27. The coincidence of the three rainy days with the autumnal equinox, is interesting. The spring equinox is not marked by any increase in rain frequency.

The author holds that we are not yet able to trace definite periodicities in the sequence of weather; and that, notwithstanding much that has been written and claimed, it is not easy to identify wet and dry periods. Even Brückner's 35-year period is regarded as of doubtful validity.

In the section on the application of meteorology to the military arts the author quotes the description of the battle of Waterloo from "Les Miserables:" "If it had not rained on the night of June 17, 1815, the future of Europe would have been changed. A few drops of rain mastered Napoleon. Because Waterloo was the finale of Austerlitz, Providence needed only a cloud crossing the sky, out of season, to cause the collapse of a world."

M. Guilbert in the preface to his work says that he wishes to give a résumé of his scientific activities covering forty years. He began in 1886 with a method of forecasting based solely on cloud formation and motion, amplified it in 1890 by a study of isobaric charts, and since 1891 followed what is known as a mixed method. The forecasts published in *Le Matin* daily, and more recently at noon by the Office National Météorologique, are based upon this combination method. The Guilbert method depends primarily upon observations of the wind. "The wind," our author says, "controls pressure and hence weather"—a view which orthodox aerographers consider heretical.

The author hits back at official forecasters by reminding them that the whole world knows that after sixty years of the weather map the forecasts are far from having a high degree of accuracy. His own predictions, based upon simultaneous study of the upper clouds and the surface conditions and certain rules, have a percentage of verification well above 80. However, in all this forecasting constant use is made of the synoptic map. What is known as the normal wind, that is a

wind where the velocity is directly proportional to the pressure gradient, is first determined. An excess abnormal wind indicates an approaching "high;" a minus abnormal a disappearing "low."

The first sixty pages are given up mainly to argument in defense of the twenty-five rules set forth in an earlier book, "Nouvelle Methode de Prévision du Temps," 1909, and reiterated in the body of this volume. Prominent French meteorologists have not hesitated to criticize these rules, and here our author in turn responds with true Gallic politeness.

Part III treats of clouds. There are some fairly good illustrations. A new name, *cirro-nimbus*, is introduced; but the illustration is suspiciously like cumulo-nimbus. Also the cloud generally called alto-cumulus now changes its name to *cirrus-moutonné;* and cirro-cumulus to *cirrus-pommelé.* A new classification is offered.

Much that follows is essentially controversial, the author criticizing pointedly the work of the Bureau Météorologique Militaire, and the successor of the Bureau Central Météorologique.

ALEXANDER MCADIE

A MEMOIR ON CLOUD SYSTEMS

P. SCHERESCHEWSKY AND P. WEHRLÉ. **Les systèmes nuageux.** Vol. 1, xvi and 77 pp., diagrs.; Vol. 2, maps; Vol. 3, photographs. *Mémorial de l'Office Natl. Météorol. de France*, Vol. 1, No. 1. L'Office Natl. Météorol. and Étienne Chiron, Paris, 1923. 12½ x 9½ inches.

The French Meteorological Office is the logical successor to the Bureau Météorologique Militaire; and in this the first year of its existence offers eleven memoirs, of which this work on clouds in three parts heads the list. Colonel Delcambre, the director of the new service, points out in the preface that a discussion of "noyaux de variations de pression" should have preceded this work on the clouds; but for various reasons the original plan could not be carried out, and so the clouds have priority. We lack an English word that will adequately translate "les noyaux de variations," and perhaps the meaning will be best brought out if we call these pressure pulses "action centers." We can do this more readily since the old "centers of action" have been replaced by "hyperbar" and "infrabar." These *noyaux* are determined not by the isobars on the synoptic map but by the isallobars and undoubtedly are of greater significance in forecasting than are the customary pressure areas.

In this work stress is laid upon the sequence of cloudiness with individual pressure distributions. Briefly, if the succession of cloud forms can be accurately forecast, then it is plain that accurate forecasts of the general weather will follow. The French and Norwegian methods of forecasting are thus somewhat alike; although the former give more weight to clouds and action centers, while the latter stress areas of discontinuity as in warm fronts and polar fronts.

In the second volume, or folder, there are thirty-three large sheets, on some of which there are as many as twelve weather charts (7.5 x 11 cms.). These maps show isobars, *noyaux*, and winds at 1000 meters with the cloud sequences.

The third volume contains 26 photogravures of cloud types, with copious notes describing the weather conditions. The photographs, however, are those of individual clouds and do not tell the whole story of the succession of clouds or even of the cloud formation in a different part of the sky. Plate 1, for example, is a beautiful cirrus on the front of a depression. This cirrus and another were the advance runners of a cloud train that crossed France from northwest to southeast on August 24, 25, and 26, 1902. A good example of mammato-cumulus is given on Plate 21. This

type, said to be rare in France, was part of a train of storm clouds crossing France June 26–30, 1917. At Paris the succession was cirrus, cirro-cumulus, cirro-stratus, alto-cumulus, then rain and low level clouds; heavy rain occurred before the appearance of the mammato-cumulus.

ALEXANDER MCADIE

PLEISTOCENE CHANGES IN THE BALTIC BASIN

WLADIMIR KÖPPEN. **Das System in den Bodenbewegungen und Klimawechseln des Quartärs im Ostseebecken.** *Zeitschr. für Gletscherkunde*, Vol. 12, 1922, pp. 97–123.

The late Pleistocene oscillations of level in northern Europe, with respect to the sea, are regarded as consequences of climatic changes related to variability in the ice load that the region had to support. Climatic evolution is considered as a consequence largely of changes in the position of the earth's poles. During the maximum of the last glaciation the north pole—according to this hypothesis—lay in Greenland. The low-pressure area which now lies at Iceland was then situated off the northwestern corner of Spain. The storm tracks now crossing Scandinavia then swept over the Mediterranean region, causing a pluvial period there. The loess may have been deposited essentially through the agency of the dry winds coming from the glacial anticyclone that is assumed to have lain over the ice sheet. The mechanism of the late Pleistocene changes of level, attributed to the loading and subsequent unloading of the ice, is treated at some length. Interestingly enough, substantially the same conclusions had already been reached by Swedish students. However, the described course of the oscillations is now out of date (see *Geogr. Rev.*, Vol. 12, 1922, pp. 602–612). The division of the Ice Age into four (or five) glacial periods may be due to cosmic periodicity through which the summer temperatures undergo considerable variations. According to M. Milankovitch's insolation curve the summer temperatures reached a minimum 25,000 years ago and a maximum 10,000 years ago. The greatest extension of the last glaciation coincided with the lowest summer temperatures, the postglacial temperature maximum with the highest. The disappearance of the last ice sheet may have begun some 25,000 years ago, but the postglacial temperature maximum prevailed from about 5500 to 2500 years ago, as shown by studies in Sweden. However, some 10,000 years ago the Scandinavian ice began to decay with catastrophic rapidity, indicating a marked increase in the summer temperature.

ERNST ANTEVS

MAN AS A GEOLOGICAL AGENT

R. L. SHERLOCK. **Man as a Geological Agent: An Account of His Action on Inanimate Nature.** With a Foreword by A. S. Woodward. 372 pp.; maps, diagrs., ills., bibliogr., index. H. F. & G. Witherby, London, 1922. 9 x 6 inches.

The author of this excellent work, using the British Isles as a type, has endeavored to show quantitatively the importance of man in modifying the surface of the earth. But he has not been content merely to estimate the quantity of material removed in the mining of coal and metalliferous ore, salt, oil shale, and excavations of other kinds, such as railroad cuts and fills. One finds under a discussion of roads, for example, a treatise on Roman roads, under coal and salt an essay on the prevention of subsidence. There are also brief histories of glass, of brick making, etc.

The discussion of denudation by excavation is necessarily largely a matter of statistics in which are computed the volume of rocks and ores taken out of the earth in mining and in the withdrawal of salt by solution. The total volume of rock excavated by man in Great Britain from various kinds of excavations is

estimated to be about 37,709,000,000 cubic yards. Denudation by attrition in roads and footpaths, in the manufacture of cement, lime, plaster of Paris, etc., is calculated to have been, in 1913, about 10,000,000 cubic yards.

An interesting chapter on subsidence due to mining and salt working considers the modification of the earth's surface which has resulted largely from the removal of salt in solution as brine. A striking example of the slowness of the natural denudation of salt as compared with its artificial removal is that of the salt mountain of Cardona, in Spain, which is said to waste, under atmospheric agents, by only four inches a century; whereas there is prospect that an area of some 200 square miles in Cheshire will in time be reduced by an average of 100 feet, which would bring much of the region below sea level.

The chapter on London is difficult for one not familiar with the city, but it is, nevertheless, a valuable study of the concentrated effect of man in changing an extensive marsh and mud-flat area into a well-drained one. The evidence indicates that the city has been raised by débris at the rate of about one foot a century.

Numerous examples of the delicate balance between erosion and deposition on the English coast are cited. The dredging out of flint pebbles, shingle, and clay ironstone concretions has caused changes in the ocean currents that have produced important modifications of the coast line. The building of dikes and the dumping of slag have caused the deposition of sediment and aggradation.

The discussion of changes of climate brought about by deforestation, by the increase in population, and by the increase in the carbon dioxide content of the air is not as convincing as other chapters.

The conclusions are that the geological effect of man's activity resembles that of a glacier more than that of any other natural agent. Morainic material bears some resemblance to the waste heaps left by man in mining and in manufacturing; eskers and kames bear a close resemblance in outward form to railroad fills; and artificial lakes to glacial lakes. Man's accomplishments are large as compared with the present work of erosion and weathering. Geikie estimated that the rate of erosion of the British Islands is equivalent to 2.72 inches in 2000 years, or less than half that due to man during the same period. In a densely populated country like England man is many times more powerful, as an agent of denudation, than all the atmospheric denuding agents combined.

Teachers of geology and geography will find in this book many interesting examples for classroom illustration.

HERDMAN F. CLELAND

HUMAN CULTURE

CLARK WISSLER. **Man and Culture.** xi and 371 pp.; maps, diagrs., ills., bibliogrs., index. (Crowell's Social Sci. Ser.) Thomas Y. Crowell Co., New York, 1923. 8 x 5¼ inches.

There is no doubt that the intelligent world is at the moment keenly interested in human problems; it has reacted from the artificialities of politics and is seeking to appreciate the subtleties of man's real problems; it is turning from the quest for power and profit and demanding information about life. Wissler's book is one response to this demand, and Goldenweiser's recent one (Early Civilization, New York, 1922) is another. They are of special interest as contributions to knowledge based primarily upon American evidences, though both authors have read and observed widely. Goldenweiser seeks to expound the various aspects of life and treats in series environment, industry, art, religion, society, and mentality and so chooses his examples as to give, in all, a fairly comprehensive treatment of five groups, the Central Eskimo, the Tlingit and Haida of Northwestern America, the Iroquois Matriarchate, Uganda, and the Central Australians. Wissler follows a much more

generalized line of thought; he treats of the meaning, form, and content of culture, its universal pattern, it acquisition and diffusion, natural and organized, with examples of the most various peoples. His work and Goldenweiser's thus supplement each other with only minor overlaps. Wissler, moreover, is very clear as to the essential unity of the problem, whether we are dealing with nature folk or so-called civilized peoples; indeed he has many acute remarks on the spread of militarism and the tendency of "the flag" to follow trade which goes with culture diffusion and attendant disorganization.

One of Wissler's most fascinating chapters draws inferences from certain examples of culture spreads. Horse culture came to post-Columbian America mainly from Spain. It spread in America faster than did the Spaniards, and the horse ran wild; nevertheless the Indians everywhere adopted accessories based on Spanish patterns, associating therewith a few local details like the bolas of South America; and the cowboy of the western plains adopted many details that the Indians acquired from the Spaniards. But, though the Spaniard rarely made the horse drag a wheeled vehicle in America, the Indian unhitched the dog from his dray or travois and put the horse to this work. He fitted the horse into the frame of his own life but copied many details which came with the horse. The spread of maize shows us very different sequences. It was cultivated in olden time along the Atlantic seaboard and the Gulf Coast of what is now the United States, and thence westward to the Mississippi the maize complex, as Wissler calls it, is uniform in all essentials; he draws the conclusion that it must have spread complete. Europeans took over this culture but in spite of their traditions, copied many details from the natives, and, modified by mechanism it is true, those native traits remain with us still. We have here probably a case of delicate adjustment to environment, and environment has encouraged the maintenance of the old traits. But maize was also taken across to the Old World, and in Europe it was an isolated culture element introduced into a complex tradition so that the cultivation of this grain in the Old World took on traits from Old World agriculture. Here again environment modified the intruding culture. Wissler makes interesting efforts to describe culture complexes and to follow diffusion of their elements, diffusion in some cases in complete form, as we see in the case of maize, but more often with progressive impoverishment as we move out from the center. The culminating traits often enough do not travel far. Culture traits of America north of Mexico are parallel with culture traits in America southeast of Peru and suggest spread in both cases from a center somewhere within the Mexico-Peru belt.

Another of the author's points is that a more or less highland belt from the Pyrenees through Asia to Patagonia grades northward into plains whose limits are tundra and in the Old World southwards into jungle, the jungle in South America being on the eastern side instead. He notes that the dark-skinned peoples are characteristic of the jungle side, that the roundheads occupy the mesa, and that the longheads, with some roundheaded intrusions, occupy the plains towards the tundra. Higher traits of culture have tended to appear chiefly in the highland zone (he calls it the "mesa") and to spread outwards.

These illustrations will show the wide range and the great value of Wissler's little book. One could wish for adjustments here and there. For example he quotes Franz Boas' conclusions as to changes in bodily form of the descendants of immigrants into the United States, though a number of workers have shown fairly clearly that Boas' evidence in this case is quite inadequate and the analysis faulty.

Again, along with acute remarks on the weak points in Elliot Smith's theory ascribing the origins of the Maya civilization of Central America to immigrants from the Old World across the Pacific, he hardly refers to some curious parallelisms in detail between Old and New Worlds which as greatly need treatment by Americanists who believe in the independence of prehistoric American culture as the detailing of analyses needs treatment by Elliot Smith and his followers. It may be that American scientists

have settled to their satisfaction the interpretation of the curious representations which Elliot Smith has suggested are based on the elephant (*Nature*, London, Vol. 96, 1915–1916); but a number of their colleagues in the Old World, including some who are very critical of many details of the migrations doctrine, would like to see this matter faced—as well as others. The fascinating and important chapter "The Domestication of Man" has interesting thoughts but is disappointing; the student should refer to the late Giuffrida-Ruggeri's "La domesticita dell' homo" in his last work "Su l'origine dell' uomo" (1921)—a book too little known among students of mankind.

H. J. Fleure

Our Daily Bread: The World Production of Food Crops

Gunnar Andersson. **Vårt dagliga bröd: Näringsväxterna i världsproduktionen.** viii and 230 pp.; maps, diagrs., ills., index. Hugo Gebers, Stockholm. 8 x 5½ inches.

"The Geography of Foodstuffs" epitomizes the message of this book. The author presents his subject in bold outline and carries his readers with swift and impressive strokes through the natural controls of plant growth to the importance of food plants in national life. There are only eight chapters, but their headings indicate that each is a thesis in itself, viz.: "Why Plants Gather Nourishment and Why We Eat Them," "What Plants Eat," "How Cultivated Plants Originated," "The World's Great Granaries," "The Importance of the Tropics in World Food Production," "Vegetable Fats as Foods," "Needs of the Swedish People in Foodstuffs," and "Future Swedish Foodstuffs Policies."

The chapter headings indicate the scope of the book. The early part of the work lays much emphasis on the botanical relations of food plants and presents a clear philosophic discussion of how early man must have blindly experimented in the selection and cultivation of the food plants that he found most desirable. Thus the debt of modern food-plant agriculture to the slow evolutionary progress of the ancients is pointed out.

In Chapter 4, "The World's Great Granaries," attention is directed to the increasing demand for foodstuffs in the world that comes with increasing population and the rising standards of living. Wheat production receives major consideration, with Indian corn (maize) second. A commendable summary study of the wheat industry of the United States, Siberia, and Argentina is here presented. Canada receives perhaps less attention than the wheat industry of that country merits, but this can readily be explained by the youth of the industry there when compared with the older regions mentioned.

The treatment of tropical foodstuffs, while necessarily brief, is gratifying in that emphasis is given to the relationship of production to altitude and rainfall. Thus the picture of diversity of products is well painted. The importance of the tropical regions is clearly demonstrated; but extravagant claims, such as often characterize publications of those who have not visited this part of the world, are refreshingly absent.

The two closing chapters deal directly with Sweden's food problem. The importance not only of the supply but of its relation to national economic and political questions is carefully presented. The emphasis here given was perhaps inspired by the trying times of the Great War. As a whole the book is a worthy and interesting discussion of the relation of food plants to natural environment and to national welfare.

Nels A. Bengtson

CORRESPONDENCE

On River Meanders

Vienna, January 14, 1924

To the Editor of the *Geographical Review:*

In the October, 1923, number of the *Geographical Review* (pp. 629–630) Mr. W. M. Davis has rather severely criticized my studies on river meanders.

Geographers and physicists sometimes have difficulty in understanding one another. A physicist who tries to apply a physical principle to a certain natural phenomenon or performs an experiment to explain it cannot expect to reproduce the phenomenon exactly. He only hopes to find out whether his theory can be applied in its essentials and whether or not his experiment gives the intrinsic process. The geographer who compares the mathematical formula or experiment with the natural phenomenon is mistaken if he thinks that such investigation of the process is of no value unless full agreement is obtained.

In the theoretical parts of my paper "Zur Theorie der Flussmäander" (*Sitzungsber. Akad. der Wiss. in Wien, Mathem.-naturw. Klasse*, Vol. 128, 1919, pp. 1453–1473) I treated the following subject: What is the reason for the formation of meanders, and how is their size related to the dimensions and velocity of the river? The oscillation formula which I gave is as simple as possible, and I stated that the formula only holds good for meanders whose amplitudes are small compared with their wave length. Therefore one cannot expect the formula to give all the natural phenomena, e. g. the cut-off of meanders.

The criticism that I took the oscillatory rolling of a ball in a trough of concave cross section as fully analogous to the oscillatory flow of a river is unjustified. I spoke of this movement of the ball at the beginning of my paper to explain the double motion of oscillation and flow. I used the formula for the seiches of water, i. e. I did not confuse the dynamics of a rolling ball with the hydrodynamics.

In the experiment for producing meanders I had to introduce a strong external cause to produce the first flexure of the river. I could not wait an indefinitely long time until accidental irregularities in the material of the river bed should produce a curvature, as is the case in nature. I therefore introduced the water from one side into the rectilineal river bed. It was and is evident that the curvature opposite the inflow could not displace itself down stream but was forced to remain in its original position. Mr. Davis finds this experimental condition erroneous. I can only say that a simple experiment is better than none.

The experiment showed quite clearly that the wave length of meanders increases with their amplitude in agreement with the theory. If this proportionality is not always to be found in nature the reason is that only high water can change the river bed essentially. Low water will keep the existing curvatures and will only slowly excavate the concave river sides.

Mr. Davis adds a criticism about a second paper of mine, "Uber Schuttböschungen und Bergformen" (*Geografiska Annaler*, Vol. 5, 1923, pp. 59–71). It was the purpose of this paper to show how the slope angle of a sand slope depends upon the radius of the curvature of the slope in a horizontal plain. I had no wish to give a dynamical explanation for the formation of the slope, but only to find the conditions for stable equilibrium. The experimental representation of forms of sand slopes in this paper was intended to show their similarity with natural mountain forms, not to explain the formation of meanders in a valley. Regarding the ironical remark of Mr. Davis about the rounding of the upper contour lines of a hill, I am sorry that he does not perceive the difference between vague and general knowledge and mathematical expressions which give quantitative results.

Felix M. Exner

Washington, March 1, 1924

To the Editor of the *Geographical Review:*

In comment upon Professor Exner's letter, I believe that the seiche formula for lakes applies very imperfectly to river meanders; for, while it may by analogy give an approximation to the transverse component of a moderately meandering river, its homological incompetence is shown by its "only holding good for meanders whose amplitudes are small compared with their wave lengths." A competent theory should hold good for meanders whose amplitude has grown to be as great as or even twice as great as their wave length, or the double distance between successive "crossings," as river pilots call the points of inflexion. Further, an experiment which shows "quite clearly that the wave length of [artificial] meanders increases with their amplitude" thereby shows also that the experiment with the artificial stream as well as the theory which the experiment illustrates cannot properly represent true river meanders; for one of the most striking features of true meanders is that their wave length remains almost constant while their amplitude increases many fold; in other words, that the down-valley distance between successive points of inflexion hardly changes at all, while the right and left curves increase very greatly in radius and arc and hence in amplitude also, even to the point of producing cut-offs. Cut-offs are quite as characteristic features of fully developed meanders as small-amplitude curves are of incipient meanders; hence a meander theory that does not take account of curves increasing up to the point of cut-offs is seriously defective. One need not expect a correct theory to explain accidental irregularities of river flow; but, if a meander theory fails to account for features so systematic and essential as curves growing till they cause cut-offs, it cannot be accepted as correct. The reason that the proportionality between wave length and amplitude of meanders is not always maintained in nature is *not* "that only high water can change the river bed essentially" but that, even at high water, the change of channel at points of inflexion is slow and small, while the increase of radius and arc in the right and left curves is rapid and large. Moreover, the small change at points of inflexion is a down-valley shift by about the same measure at successive points; hence, in spite of such change the distance between those points, or the half wave length, remains essentially constant, while the meander curves go on increasing in radius, arc, and amplitude until a cut-off occurs. Finally this constancy of meander wave length shows that the oscillatory rolling of a ball down an inclined trough of concave cross section does not provide a satisfactory analogy with a meandering river; for, when the ball passes a point of inflexion in its curved path, it is experiencing a down-valley acceleration as strong as at every other point, and the wave length of its path therefore increases properly enough; but when a meandering river passes a point of inflexion, it has no *down-valley* acceleration at all, but only a *down-stream* acceleration; hence its wave length does *not* increase. In meanders of greater arc than 180° the down-stream acceleration at the inflexion points may even be directed obliquely *up-valley;* but the wave length of such meanders is not shortened any more than the wave length of more open meanders is lengthened.

W. M. Davis

Aberystwyth, April 19, 1924

To the Editor of the *Geographical Review:*

The reviewer of Dixon's "Racial History of Man" in the April number of the *Geographical Review* (pp. 334–336) wishes to acknowledge an oversight in his review. He had not found Professor Dixon's reference to the probable dominance of brachycephaly which occurs on page 512 of the book.

H. J. Fleure